DELHI COLLEGE OF ENGINEERING

सत्यमेव जयते

LIBRARY

Kashmiri Gate, Delhi-110006

Accession No. 50627

Class No. 621.[illegible]

Book No. [illegible]

Borrower is requisted to check the book and get the signatures on the torned pages, if any.

DELHI COLLEGE OF ENGINEERING
Kashmiri Gate, Delhi-110006
LIBRARY

DATE DUE

For each day's delay after the due date a fine of **10 Paise** per Vol. shall be charged for the first week, and **50 Paise** per Vol. per day for subsequent days.

Borrower's No.	Date Due	Borrower's No.	Date Due

LIBRARY
OF
PRACTICAL ELECTRICITY

VOLUME VII

ENGINEERING LIBRARIES

OF THE

McGRAW-HILL BOOK COMPANY, INC.

	PER SET
THE MINING LIBRARY, 9 VOLUMES, 6 x 9, Illustrated	$24.00
THE POWER PLANT LIBRARY, 8 VOLUMES, 5½ x 8¼, Illustrated	$12.00
THE MACHINE SHOP LIBRARY, 9 VOLUMES, 6 x 9, Illustrated	$16.00
LIBRARY OF COAL MINING AND ENGINEERING, 8 VOLUMES, 5½ x 8¼, Illustrated	$16.00
LIBRARY OF PRACTICAL ELECTRICITY, 8 VOLUMES, 4⅞ x 7¾, Illustrated	$16.00
RADCLIFFE HOME STUDY COURSE IN PRACTICAL ELECTRICITY, 3 VOLUMES, 5½ x 8¼, Illustrated	$6.00

SOLD BY SUBSCRIPTION ONLY

FOR DETAILED DESCRIPTIONS AND TERMS OF PAYMENT APPLY TO

SUBSCRIPTION BOOK DEPARTMENT

OF THE

McGRAW-HILL BOOK COMPANY, INC.
239 WEST 39TH ST. NEW YORK

WIRING OF FINISHED BUILDINGS

A PRACTICAL TREATISE, DEALING WITH THE
COMMERCIAL AND THE TECHNICAL PHASES
OF THE SUBJECT, FOR THE CENTRAL-
STATION MAN, ELECTRICAL CON-
TRACTOR AND WIREMAN

BY

TERRELL CROFT
CONSULTING ELECTRICAL ENGINEER

FIRST EDITION
THIRD IMPRESSION

McGRAW-HILL BOOK COMPANY, INC.
239 WEST 39TH STREET. NEW YORK

LONDON: HILL PUBLISHING CO., LTD.
6 & 8 BOUVERIE ST., E.C.

COPYRIGHT, 1915, BY THE
McGRAW-HILL BOOK COMPANY, INC.

THE · MAPLE · PRESS · YORK · PA

PREFACE

It has been estimated, and probably the estimate is not very far from the truth, that only 8 per cent. of all of the houses in this country are wired for electricity. No further argument to justify the issuance of "*Wiring of Finished Buildings*" seems necessary. There is a splendid, lucrative field awaiting the central-stations, the electrical contractors and the wiremen that seek and install this finished-building business in a systematic, comprehensive way. This work has been prepared to assist them.

Both the *commercial* and the *technical* aspects of the topic are treated in this one volume. The commercial man should know something of the details of finished-building wiring and the technician should be somewhat familiar with the business end. Frequently the contractor must know both ends.

In 1911 the author prepared for *The Electrical World* a series of articles on "*Wiring Old Houses*" that ran through a half dozen issues. The essential information from this series and from other articles by the author formed the basis of the present work. With this has been included much other data.

Criticisms and suggestions for the improvement and enlargement of the book will be welcomed by the author.

TERRELL CROFT.

UNIVERSITY CITY,
ST. LOUIS, MO.
January, 1915.

ACKNOWLEDGMENTS

The author desires to acknowledge the permissions granted by the editors of the American electrical magazines to use herein material from articles prepared by him and by others. Special acknowledgment is hereby made to *The Electrical World*, *The Electrical Review and Western Electrician*, *Electrical Engineering*, and *Popular Electricity*.

Acknowledgment is also accorded to Mr. Howard H. Wood, Superintendent of the Wiring Department of the Allegheny County Light Company, Pittsburgh, for much valuable assistance and the many suggestions that he gave in connection with the preparation of the original series on "*Wiring Old Houses*" which was printed in *The Electrical World* in 1911.

Data have been obtained from National Electric Light Association publications and special acknowledgment is made for material taken from the 1913 and the 1914 "*Reports of the Committee on Wiring Existing Buildings*" of that association.

Other acknowledgments are made in the text of the book.

Different central-stations throughout the country have kindly checked over figures relating to their own stations.

CONTENTS

PAGE
PREFACE v
ACKNOWLEDGMENTS vii

COMMERCIAL SECTION

CHAPTER I

POSSIBILITIES AND RESULTS
Business already obtained 1
Business that is yet to be obtained 2
Rate of growth 2
Possibilities of the small customer 3
Results from finished-building wiring campaigns 4

CHAPTER II

ADVERTISING
General 6
Methods of advertising. 7
Newspaper advertising 9
Circular letters 11
Street car cards 12
Posters and bill-board advertising 13
Display cards 14
Window display advertising 15
Circulars and folders 15
Handbills 18
Electric signs 19
Personal canvass 19
Miscellaneous methods 20
Examples 21

CHAPTER III

SOLICITATION
Qualifications for solicitors 25
Solicitation districts 26
Solicitation card records 27
Estimating 28
Special solicitation methods. 30

CHAPTER IV

POLICIES
General 32
Methods of payment. 32

PAGE
Relations with contractors 33
Estimating and prices 35
Policy in regard to fixtures 36
Policy in regard to furnishing lamps 37
Controlled-flat-rate method of charging. 38

CHAPTER V

EXAMPLES OF CAMPAIGNS

Byllesby Company campaigns 39
Campaign of Union Electric Co., St. Louis 44
Campaign in Boston, Mass.. 45
Campaign of Brooklyn, N. Y., Edison Co. 46
Campaigns in Pittsburgh, Pa.. 47
Kansas City campaign 49
Campaigns in smaller cities and towns 50

CHAPTER VI

COSTS AND PRICES

Methods of determining costs and prices 54
Estimates and their compilation 55
Standardized or unit prices 56
N.E.L.A. cost and price data 60
Miscellaneous cost data 62
Cost and price tables for different methods of wiring and different localities 69

APPENDIX TO COMMERCIAL SECTION

SPECIFICATION FOR A FINISHED-BUILDING WIRING CAMPAIGN

Foreword. 85
Outline of campaign 86
Form of campaign 93

TECHNICAL SECTION

CHAPTER VII

METHODS OF WIRING

General 101
Rigid iron conduit wiring. 102
Flexible metallic conduit and flexible steel armored cable wiring 113
Combination rigid and flexible conduit 119
Knob and tube wiring 123
Metal molding wiring 128
Wooden molding wiring 130
Methods used in Europe

CHAPTER VIII

PAGE
PLANNING INSTALLATIONS
Underwriters' and municipal requirements 144
General considerations 144
Branch circuits, distribution centers and panel boxes. 146
Building construction 150
Three-way and emergency switch circuits. 153

CHAPTER IX

TOOLS AND MANIPULATION
Neatness and how attained 157
Removal of floor boards and making of pockets 159
Removal and replacement of trim 168
Cutting outlet holes 169
Boring and boring tools 170
Exploring lamps and devices and their application 178
Fishing and fishing devices 183
Running conductors to side outlets 200
Running conductors to center outlets 209
Miscellaneous methods. 212

CHAPTER X

EXAMPLES OF INSTALLATIONS
Installations without panel boxes 217
Installations with panel boxes. 234
Miscellaneous installations 249

CHAPTER XI

FIXTURES
Fixtures for finished-building installations 252
Illustrations and costs of fixtures 254
Finished-building fixture sets 255
INDEX 257

WIRING
OF
FINISHED BUILDINGS

CHAPTER I

POSSIBILITIES AND RESULTS

1. Business Already Obtained. It is difficult if not impossible to secure authoritative figures relating to this matter. Probably the best data that have thus far been compiled are those contained in the 1914 *Report of the Committee on Wiring Existing Buildings* of the National Electric Light Association. The values therein given are undoubtedly accurate. They are reproduced in Table **6** and show that, in different sections of the country, the number of central-station customers ranges from 20 to 200 per 1000 population. However, as indicated by the table, in most of the cities there are at present somewhere around but 50 or 60 customers per 1000 population. Furthermore, the data were furnished by a "*selected list of reporters only*" and may or may not be representative of the entire country. The names of the cities referred to in the table have been concealed by the committee. It is altogether probable that, in cities and towns over the entire United States, the number of customers per 1000 population is considerably below 50. In Strassburg, Germany, and in Milan, Italy, the development has already reached a value well over 150 customers per 1000 population.

1a. Percentage of Houses, in Cities of 20,000 Population and Under, Wired for Electricity.[1] From returns made to the *Electrical World* by central stations in all sections of the country, the number of houses in cities of 20,000 and less inhabitants which are equipped to use electricity varies with the localities. Returns from 100 cities of a population of 5000 or less taken at random from all parts of the country indicate that 58 per cent. of the houses are wired. In cities with a population ranging from 5000 to 10,000 the percentage is 54. Thirty-two cities with populations of more than 10,000 and less than 20,000 show that 60 per cent. of the houses are wired. In the newer sections of the country west of the Mississippi the percentages are considerably higher than in the older sections. On the Pacific Coast the percentages run as high as 98, while in the Middle West the average is over 60 per cent. The Atlantic Coast shows the lowest percentage. These figures are not, however, absolutely accurate and would not be true of all of the cities in the country having a population of 20,000 and under. They are based on incomplete returns for the entire country and represent the conditions in progressive communities. If complete returns were available, the percentages would be doubtless lower. However, the returns for the Middle West and the Pacific Coast represent conditions accurately for those sections.

---

[1] *Electrical World*, Oct. 17, 1914, page 774.

2. Business that is yet to Be Obtained in Finished Buildings. No absolutely definite and accurate information is available. In a few cities the number of illuminating gas consumers is practically 250 per 1000 population and there is no apparent reason why the electrical development should not at least equal this. It is altogether probable that the electric will exceed the gas development. It is apparent, from a consideration of the values given in Table **6** and in this and the preceding paragraphs, that any central station that does not now have at least 200 customers per 1000 population has splendid possibilities ahead of it. P. L. Miles is authority for the estimate that, considering the entire country, "only about 8 per cent. of all houses are equipped for electricity," the value including both urban and suburban homes. In Toledo, Ohio, there are approximately 55,000 homes and 9000 electric light users, a development of 16 per cent.

3. Rate of Growth. Table **6** shows that each central station consulted showed an increase in business for the year. This increase is, doubtless, general over the entire country. In cities where finished-building wiring campaigns have been or are being waged, the growth is much more rapid than elsewhere. In the National Electric Light Association *Wiring of Existing Buildings*

Report, previously referred to, it is brought out that the growth appears to be proportional to the number of existing customers. That is, the more customers a central station has, the more it may expect to get. This is attributed to the fact that the most effective solicitors that a central station has are its customers. If one family has electric light the neighbors want it too. Fig. 1 illustrates this fact very nicely. It is the map of a certain large city. Each black dot indicates the location of a wired finished building. The illustration shows conditions about three years after the inauguration of an aggressive finished-building wiring campaign. It will be noted that the wired finished buildings tend to lie in groups or clusters in many instances. This is attributed to the effect of the gossip and of the gratuitous solicitation service of the people residing in the respective districts.

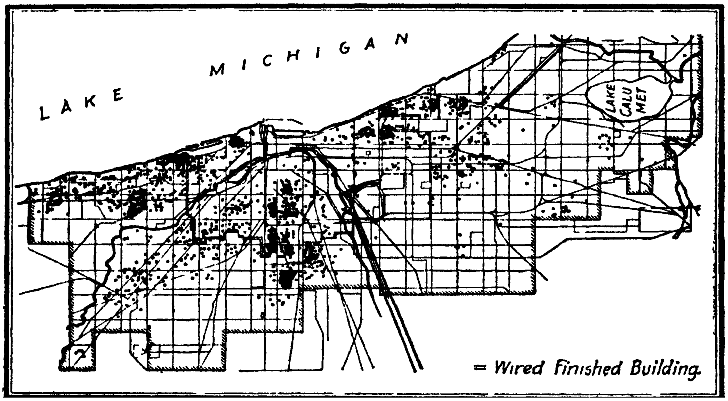


FIG. 1.—Illustrating the tendency of finished-building wiring installations toward grouping.

4. Possibilities of the Small Customer. It is from the small user that most of the future finished-building business will come. A large majority of the larger buildings are already wired. The average income from these small buildings may not exceed $10 to $16 each annually, but in the aggregate the revenue will reach a very substantial amount. Such consumers must be connected at minimum cost. Expensive service runs and expensive meters cannot be used. Considerable success has resulted in Pittsburgh and in other places from charging the small consumer on a flat-rate basis and using a maximum demand indicator or a current-limiting device to protect the central station against theft of electricity (Par. **57a**). This arrangement eliminates meter-reading charges and minimizes the bookkeeping. It is probable (National Electric Light Association *Report*) that the average annual gross income from the finished buildings that are not now but will be wired will be something less than $12 each.

5. Results from Finished-building Wiring Campaigns. A study of the data given in the chapter "*Examples of Campaigns*" will convince one of the gratifying results that can be obtained by going after the finished-building business in a systematic way with proper advertising, solicitation and price schedules. As one example of what may be accomplished the following data, relative to the Duquesne Light Company of Pittsburgh, are given:

More than 6500 finished buildings have been wired. In dollars and cents the results are indicated by the following figures which show the amounts collected during various years for wiring: 1907, $2772; 1908, $4269; 1909, $15,198; 1910, $30,125; 1911, $68,586; 1912, $85,305; 1913, $72,962 and 1914, $65,000. Aggressive advertising and solicitation was started during the latter part of 1910. The figures show the result. See **61** for description of campaign.

6. Table Indicating the Status and Possibilities of Finished-building Wiring. (See following table.)

From 1914 Report of Committee on Wiring Existing Buildings, National Electric Light Association.

Key Number	Location	Population	Customers per 1000 population[1]	Residence customers per 1000 population[1]	New buildings per 100,000 population[2]	Per cent of new buildings wired	Old buildings wired during a year per cent. to single dwellings already served at beginning of year
1	East	Over a million	45 54	19 25	95	90	8
2			20 26	19 12	108	51	5
3			26 30	12 16	88	90	2
4		Between 100 000 and 300 000	50 70	28 44	322	100	20
5			50 62	50 62	268	95	6
6			23 27	10 11	62	56	17
7			27 35	12 18	83	90	3
8		Between 50 000 and 100 000	37 42	25 29	202	85	21
9			26 32	11 16	44	00	36
10		Between 20 000 and 50 000	58 66	33 38			4
11			72 78	55 60	26	100	4
12			50 61	29 40	198	87	12
13			37 46	14 20	145	72	18
14		Between 10 000 and 20 000	49 54	36 39	263	70	3/10
15	West	Between 300 000 and 500 000	154 158	121 129	373	100	0
16			43 62	25 40	2000	83	3
17	Middle West	Between 300,000 and 500 000	42 45				
18		Between 100 000 and 300 000	110 135	78 96	1220	50	10
19		Between 20 000 and 50 000	71 79	34 41	382	66	12
20			22 28	9 11	1192	60	
21		Between 10 000 and 20 000	72 75	40 44	300	83	
22	West	Under 10,000	209 169	105 135	1647	85	3
23			72 78	49 52	11		2
24			108 120	77 89	267	67	2
25			82 87	72 84	555	96	10
26			71 78	56	167	67	14
27			126 138		381	75	
28			111 109	80 82	24	50	4
29	South-west	Between 30,000 and 50,000	61 88	63 77	118	84	23

---

[1] The first figure is for one year earlier than the second

[2] Single dwellings Apartments and stores not always included.

CHAPTER II

ADVERTISING

7. Advertising is essential in successful finished-building wiring campaigns. It is obvious that unless the public knows that a campaign is being conducted and is generally familiar with the propositions offered and the advantages accruing through the use of electricity, the campaign can hardly be successful. Advertising will disseminate this knowledge. There appears to be no one means of advertising that should be used to the exclusion of the others. On the contrary, experience has shown that best results are obtained when several means are used conjunctively. For example: newspaper advertising, circular letters and window displays have all been used at the same time and coordinately, with splendid results. In some campaigns, practically all of the methods of publicity have been used simultaneously, with gratifying returns. The people who are not reached by one means may be by another. Some people are probably reached by all, in which case the cumulative effect is powerful. Advertising may assist in one of three ways: (1) It may get direct orders, (2) it may pave the way, rendering the solicitor's work easier, and (3) it may attract inquiries which the solicitor can follow up.

8. The Desideratum of Finished-building Wiring Campaign Advertising. The general object is to induce the owners to modernize the many thousands of unwired houses. They must first be convinced that electricity is cheap and efficient—even necessary for the ordinary comforts of life. Next, there is the problem of cost. The householder must be shown that neither the installation of wires and fixtures nor the use of electric current is expensive. Finally, the house owner and, more particularly, the housewife must be assured that the wiring will be installed without noticeable damage to the building and without creating much dirt.

9. A house-wiring campaign can often be effectively preceded by an educational campaign to overcome houseowners' prejudice and to popularize the use of electricity. Nothing creates a desire to use electricity as effectively as does the introduction of labor-saving household appliances. These should be supported by the persistent arguments that they can be operated cheaply, that they solve the servant problem, that they eliminate drudgery and add to the comfort and efficiency of the housewife and her maid. The wiring of an old house often is traced directly to the desire of the housewife to use an electric iron, washing machine, vacuum cleaner or cooking appliance. The rapidly spreading desire for labor-saving electrical appliances has been indicated in several campaigns by the large number of baseboard outlets and floor receptacles requested.

10. Advertising cost of a wiring campaign varies with the conditions in the different communities. No data can be given. Newspapers with the best and largest circulations should be selected and the cost of advertising should be regulated according to the returns. To maintain the advertising cost at a minimum, the advertising department should be in daily touch with the contract department and the amount of advertising should be determined by the amount of business received.

11. Bringing the Bargain Feature into Wiring Campaigns. In the electrical business, as in the department store game, much may be gained by the inducement of cut rates. Due to department store advertising, the American public has developed the confirmed habit of bargain-hunting. Cut-price sales of electrical appliances not only will induce many housewives to ask for the installation of wiring in their homes, but will put the appliances on the central-station lines as consumers of electricity. A bargain in wiring may also be offered as an inducement to have the wiring done within a certain time limit. The standing of the illuminating company will assure its prospective patrons of first-class workmanship in the installation and the fulfillment of all the terms of the advertised offer.

12. The different methods or mediums of advertising may be listed as follows—the list may not be complete but it indicates the most important methods. The items in the list are arranged arbitrarily.

1. Newspaper Advertising.
2. Circular Letters.
3. Street Car Cards.
4. Posters—Bill-board Advertising.
5. Display Cards.
6. Window Display.
7. Circulars and Folders.
8. Handbills.
9. Electric Signs.
10. Personal Canvass.

Each of these different methods will be briefly treated in paragraphs that follow.

13. The relative values of the various methods of advertising probably differ in each community, with the nature of the proposition and with the class of people to whom the appeal is made. A very interesting tabulation relating to this subject is that of Par. **14,** which was compiled by Charles Munson, local manager for the Iowa Railway and Light Company, at Marshalltown, Iowa (*Electrical World*). As each contract was closed the customer was requested to state which method of advertising aroused his interest. The data of the table is the result of their answers Probably the effect of window-display advertising would be less important in larger cities than in Marshalltown. In cities of populations up to possibly 20,000 inhabitants almost every one walks along the main street nearly every day, and an attractive window display can be made very powerful. It is conceded that newspaper advertising is practically always essential, particularly in the larger towns and cities. The personal canvass is also essential, though this method more properly should be classed under *Soliciting* and is treated elsewhere.

14. Table Indicating Relative Values of Different Methods of Advertising. This table records the results of a campaign, of one

Method of advertising	Per cent.	Watts	Amount
Window display	30	8829	$729.30
Handbills	10	2943	243.10
Newspapers	10	2943	243 10
Office employees	10	2943	243.10
Outside employees	10	2943	243.10
Personal canvass	15	4420	364.65
Neighborhood canvass	10	2943	243.10
Street car advertising	5	1471	121.55

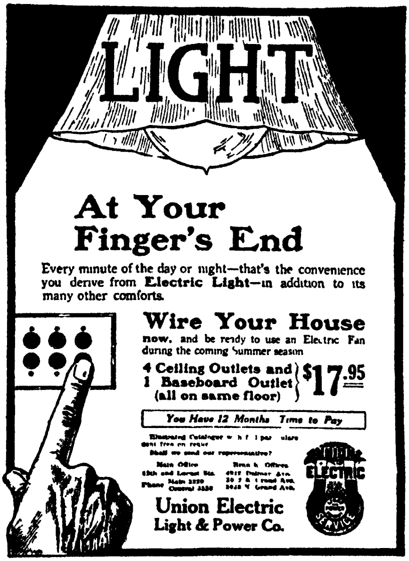
Total residence wattage secured 34,285

Total contracts given to contractors 91

Total amount of contracts $2,431.40

month's duration, in Marshalltown, Iowa, a city of 13,500 (1910 census) inhabitants. See **13.**

15. Newspaper advertising will give results, particularly in large cities, that can be attained by no other means. It is impracticable, if not impossible, to give any rules as to how much space should be carried and as to how often the advertisements should be run. The class of people that the advertiser is trying to reach and the characteristics of his proposition are factors in the matter. In other paragraphs are given outlines of successful campaigns that have been waged. From these the reader can obtain suggestions as to newspaper advertising policies that have been adopted with good results. As a general rule "fine writing," flashy headlines and the like should be avoided. It has been found that plain, concisely-worded statements are the most effective and inspire the most confidence in the reader. Reading notices in conjunction with display advertising are often valuable. Line cuts of bold rendering should be used freely as they will attract attention where it can be gained by no other means. Fig. 1*A*


ELECTRIC
SERVICE

LIGHT

At Your Finger's End

Every minute of the day or night—that's the convenience you derive from **Electric Light**—in addition to its many other comforts.

Wire Your House

now, and be ready to use an Electric Fan during the coming Summer season

4 Ceiling Outlets and
1 Baseboard Outlet
(all on same floor)
$17.95

You Have 12 Months Time to Pay

Illustrated Catalogue with full particulars sent free on request

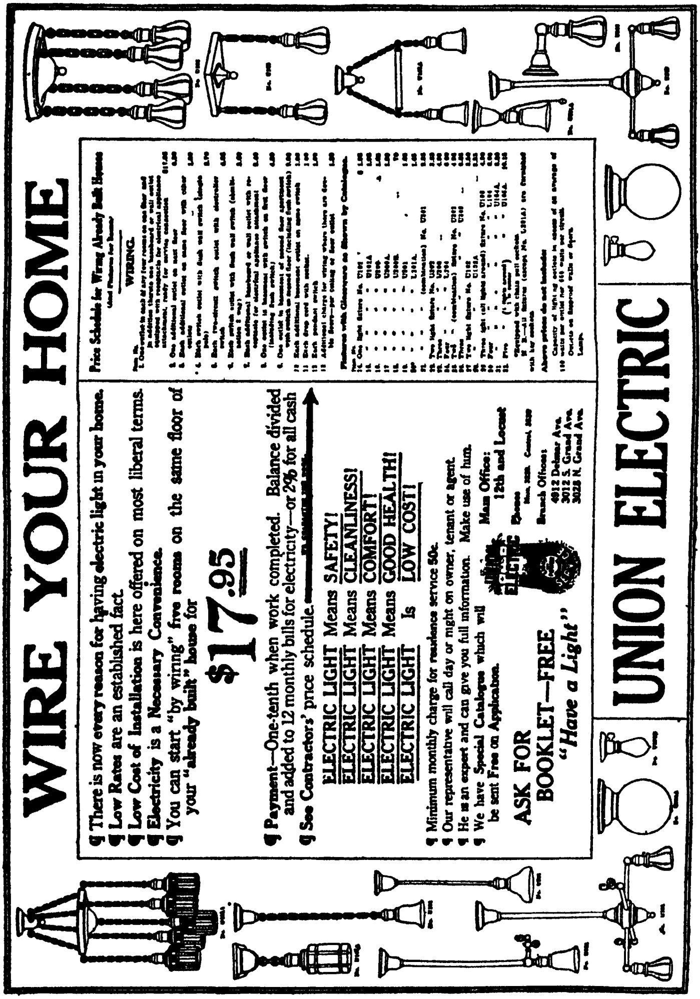
Shall we send our representative?

Main Office
Branch Offices

Union Electric
Light & Power Co.

FIG. 1*A*.—A good newspaper advertisement.

shows a good newspaper advertisement. Illustrations of typical newspaper advertisements are shown on other pages.



WIRE YOUR HOME

¶ There is now every reason for having electric light in your home.
¶ Low Rates are an established fact.
¶ Low Cost of Installation is here offered on most liberal terms.
¶ Electricity is a Necessary Convenience.
¶ You can start "by wiring" five rooms on the same floor of your "already built" house for

$17.95

¶ Payment—One-tenth when work completed. Balance divided and added to 12 monthly bills for electricity—or 2% for all cash
¶ See Contractors' price schedule.

ELECTRIC LIGHT Means SAFETY!
ELECTRIC LIGHT Means CLEANLINESS!
ELECTRIC LIGHT Means COMFORT!
ELECTRIC LIGHT Means GOOD HEALTH!
ELECTRIC LIGHT Is LOW COST!

¶ Minimum monthly charge for residence service 50c.
¶ Our representative will call day or night on owner, tenant or agent.
¶ He is an expert and can give you full information. Make use of him.
¶ We have Special Catalogue which will be sent Free on Application.

ASK FOR
BOOKLET—FREE
"Have a Light"

Main Office:
12th and Locust
Phones
Main, [illegible]. Central, [illegible]
Branch Offices:
4912 Delmar Ave.
3012 S. Grand Ave.
3028 N. Grand Ave.

Price Schedule for Wiring Already Built Houses

WIRING.

Fixtures with Glassware as Shown by Catalogue.

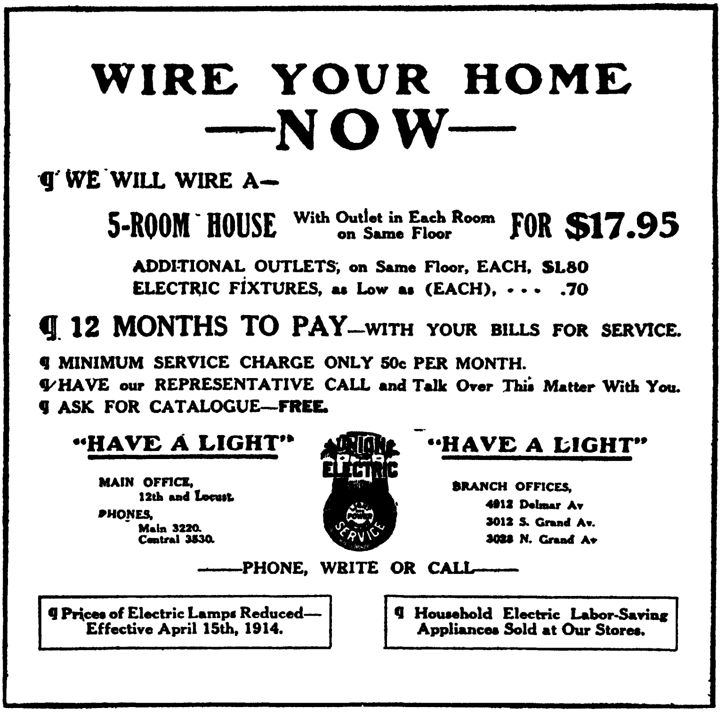
Above prices do not include:

UNION ELECTRIC

FIG 2.—Half page (11 in. × 16 in.) advertisement used by the Union Electric Light & Power Company. (A detail illustration of the fixtures is given in Fig. 185.)

16. Some sample newspaper advertisements are shown in Figs. 2 and 3. These were used by the Union Electric Light & Power Company in its campaign which is described elsewhere.

Larger illustrations of the fixtures offered are shown in the chapter on "*Fixtures.*"



WIRE YOUR HOME
—NOW—

¶ WE WILL WIRE A—

5-ROOM HOUSE With Outlet in Each Room on Same Floor FOR $17.95

ADDITIONAL OUTLETS, on Same Floor, EACH, $1.80
ELECTRIC FIXTURES, as Low as (EACH), ...70

¶ 12 MONTHS TO PAY—WITH YOUR BILLS FOR SERVICE.

¶ MINIMUM SERVICE CHARGE ONLY 50c PER MONTH.
¶ HAVE our REPRESENTATIVE CALL and Talk Over This Matter With You.
¶ ASK FOR CATALOGUE—FREE.

"HAVE A LIGHT"

MAIN OFFICE,
12th and Locust.
PHONES,
Main 3220.
Central 3530.

UNION ELECTRIC SERVICE

"HAVE A LIGHT"

BRANCH OFFICES,
4912 Delmar Av
3012 S. Grand Av.
3028 N. Grand Av

——PHONE, WRITE OR CALL——

¶ Prices of Electric Lamps Reduced—Effective April 15th, 1914.

¶ Household Electric Labor-Saving Appliances Sold at Our Stores.

FIG. 3.—Newspaper advertisement (9 in. × 9 in.) used by the Union Electric Light & Power Company.

17. Circular letters reach certain people, particularly women, who, apparently, can be reached by no other method. Typewritten letters are preferable, but if printed ones must be used they should be printed in typewriter type by a concern that is familiar with the preparation of imitation typewritten letters. The ink used in the printing should be matched with the typewriter ribbon that is used for writing in the names and addresses. Each letter should be signed in ink—by a clerk—with the name of some department head or official. Each letter should go out in a sealed envelope under a two-cent stamp. Every effort should be made to make the letter appear a personal communication. The text of the letter must be determined by circumstances. If preliminary to a campaign it may be educational. If during a campaign it may direct attention to the company's proposition or it may suggest that the prospect should have a solicitor call. When the name of an individual who has shown interest in a wiring proposition is once on the "prospective" list, follow-up circular letters can be sent to him to supplement the calls of the solicitor. Some typical circular letters are shown in the appendix to the commercial section of this book.

18. Circular letters in a Boston, Mass., campaign were used to good advantage. The Edison Electric Illuminating Co. of Boston sent out broadcast to prospective customers individually addressed letters showing what could be accomplished for the basic investment of $14.35. On the border of the letter were reproduced ten photographs showing the different forms of service which might be obtained from a single outlet—with from one to three sockets. See **60** for outline of the Boston Company's proposition.

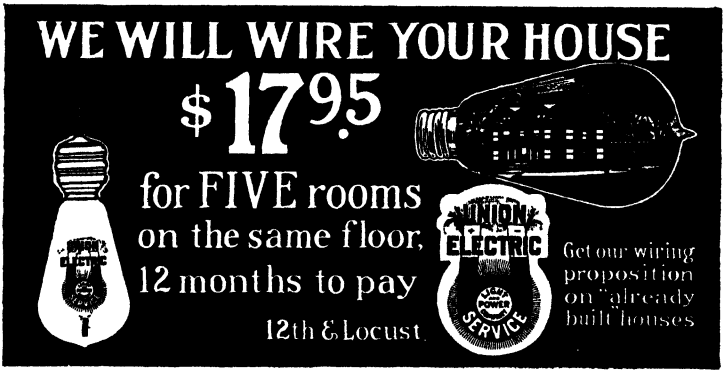


FIG. 4.—Street car card used by the Union Electric Light & Power Company.

19. Street Car Cards. A standard street car card is 21 × 11 in., but double cards, that is, 42 × 11 in., are sometimes used. Street car advertising must always be supplemental because the lettering should be large to be easily and quickly read, hence there is not enough room to tell much of a story. Street car announcements serve to hammer in and clinch statements made elsewhere and they should not be used for anything else. It has been stated that, in large cities, street car advertising brings a statement before a greater number of people, or before the same people a greater number of times, than is possible with any other form of advertising. Rental charges for street car card space vary from 25 cents to 60 cents per month per card. The price is determined by the class of community the car line traverses, the size of the city and by other considerations. The Union Electric Company used car cards like that shown in Fig. 4. While it was impossible to trace the direct results of these, the opinion is that they were very helpful. Table **14** shows that in the Marshalltown campaign only 5 per cent. of the orders were directly traceable to street car advertising.

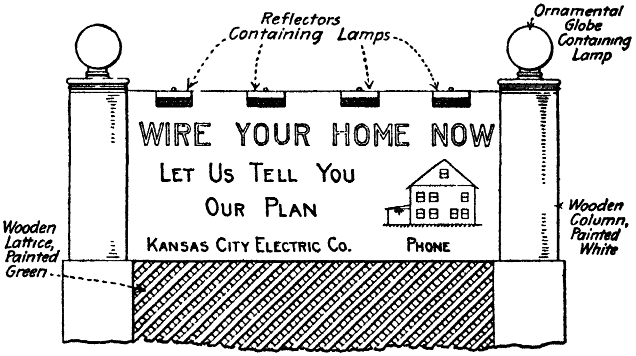
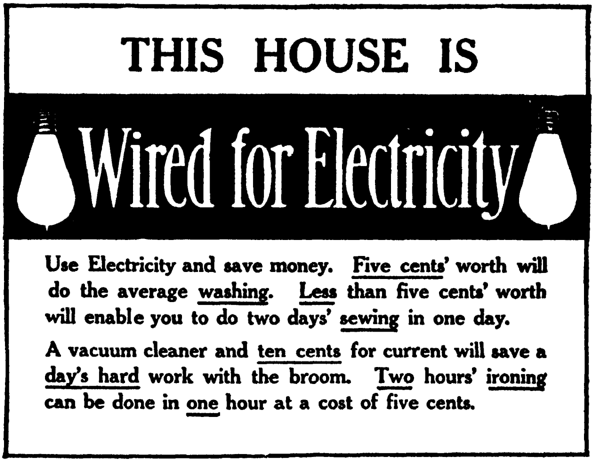

Reflectors Containing Lamps
Ornamental Globe Containing Lamp
WIRE YOUR HOME NOW
LET US TELL YOU OUR PLAN
KANSAS CITY ELECTRIC CO.
PHONE
Wooden Column, Painted White
Wooden Lattice, Painted Green

FIG. 5.—Illuminated sign.

20. Posters and bill-board advertising has been used in finished-building wiring campaigns. It is no doubt very effective when used in conjunction with other mediums but no definite data appear to be available as to just how valuable it is.

21. Illuminated Sign Advertising at Kansas City, Mo. (*Electrical World*, July 5, 1913). The Kansas City (Mo.) Electric Light Company effected an agreement with the Thomas Cusack Sign Company whereby the electric-service company lighted 250 lineal ft. of signboard (Fig. 5) upon which its advertisements are painted by the sign company. As soon as one display space is sold to a customer desiring a lighted board the lighting company's sign is transferred to another board, still retaining 250 ft. of space. The success of the plan has been marked, for no sooner has the electric service company occupied and lighted a board than it has been demanded by some prospective advertiser.

22. Display cards and "To Let" cards are cheap and, apparently, are splendid supplementary mediums. Properly worded display cards can be tacked on the lighting company's poles or hung in the windows of vacant houses that are wired and are to rent. The cards should feature the idea that no one should rent an unwired building as any building can, through the illuminating company, be cheaply, safely and quickly wired. See Fig. 6.



THIS HOUSE IS

Wired for Electricity

Use Electricity and save money. Five cents' worth will do the average washing. Less than five cents' worth will enable you to do two days' sewing in one day.

A vacuum cleaner and ten cents for current will save a day's hard work with the broom. Two hours' ironing can be done in one hour at a cost of five cents.

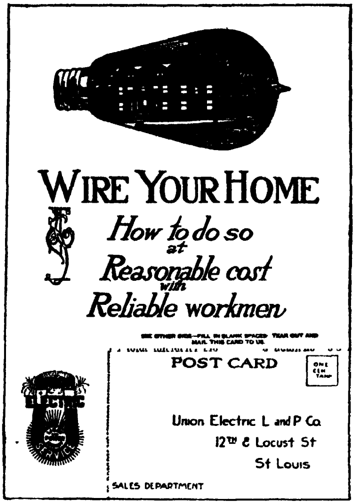
FIG. 6.—Finished-building wiring campaign placard. Size 13 in. × 11 in.

23. Display cards or placards were used in the Manchester, N. H., campaign for wiring finished buildings. All real estate dealers were supplied with placards 11 in. by 13 in. of the type shown in Fig. 6. The advantages of electric washers, motor-driven sewing machines, and vacuum cleaners were indicated to advantage on these cards. Window displays also were featured. In these a residence-type meter, main switch and fuses were wired to various appliances in operation to convince the prospective customer of the simplicity of electric service.

24. Use of Photographs of Installations in a Finished-building Wiring Campaign. One of the chief difficulties encountered during a campaign is the belief that some people possess, that it is impossible to wire an occupied building without spoiling all the walls, getting dirt over the entire place and disorganizing things generally. If these people can be convinced that they are wrong they usually become interested. To prove that the installation would be made with a minimum of damage or dirt, the contracting agent of the Kansas City Electric Light Company secured photographs of wiring jobs during different stages of the work. Enlargements of these pictures, mounted on electrically lighted easels and arranged with holders for the wiring campaign literature, were placed in drug stores throughout the residence district.

25. Window display advertising, particularly in towns of less than, possibly, 20,000 inhabitants, is one of the most resultful means of publicity available to the central station or contractor. The values of Par. **14** indicate that in that particular campaign the window display advertising was much more valuable than any other means employed. The window display should be such as will compel attention. Some device in action will usually draw a crowd. If fixtures are offered in the campaign, a set can be displayed and a placard should indicate their price and the room for which each fixture of the set is intended. A small section of a frame house can be built in the window and the wiring in it shown so as to indicate how wiring can be installed in a finished building without visible damage. The process of finishing between outlets can also be illustrated. Placards should plainly state the company's wiring offer.

26. Circulars and folders can be used in important campaigns to supplement the other mediums. A good circular outlining the advantages of electric service and the ease with which houses may be wired can be sent to all inquirers, to precede the solicitor, or the circulars can be sent over a selected list. Fig. 7 shows the cover of an excellent six-page-and-cover circular (8 1/2 in. × 12 in.) used by the Union Electric Company of St. Louis. The reverse side of the cover, showing the return card, is illustrated in Fig. 8. Pages 1 and 2 explain how readily houses can be wired and the desire of the company to assist toward this end. The advantages of electric service, the installment plan of payment which the company adopted, and the guarantee under which the wiring is installed are all outlined on page 3. On page 4, large illustrations of the fixtures included in the company's offer are shown. (See Fig. 203 for pictures of these fixtures.) Pages 5 and 6 comprise the Order or Contract form for wiring finished buildings which is reproduced in Figs. 9 and 10. This contract form sheet is perforated along its edge so that it can be easily removed from the circular.



WIRE YOUR HOME

How to do so at Reasonable cost with Reliable workmen

SEE OTHER SIDE—FILL IN BLANK SPACES TEAR OUT AND MAIL THIS CARD TO US.

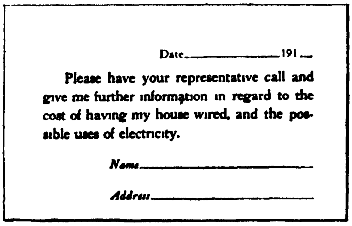
POST CARD

ONE CENT STAMP

Union Electric L and P Co
12th & Locust St
St Louis

SALES DEPARTMENT

FIG. 7.—Cover of circular on finished-building wiring.



Date____________191__

Please have your representative call and give me further information in regard to the cost of having my house wired, and the possible uses of electricity.

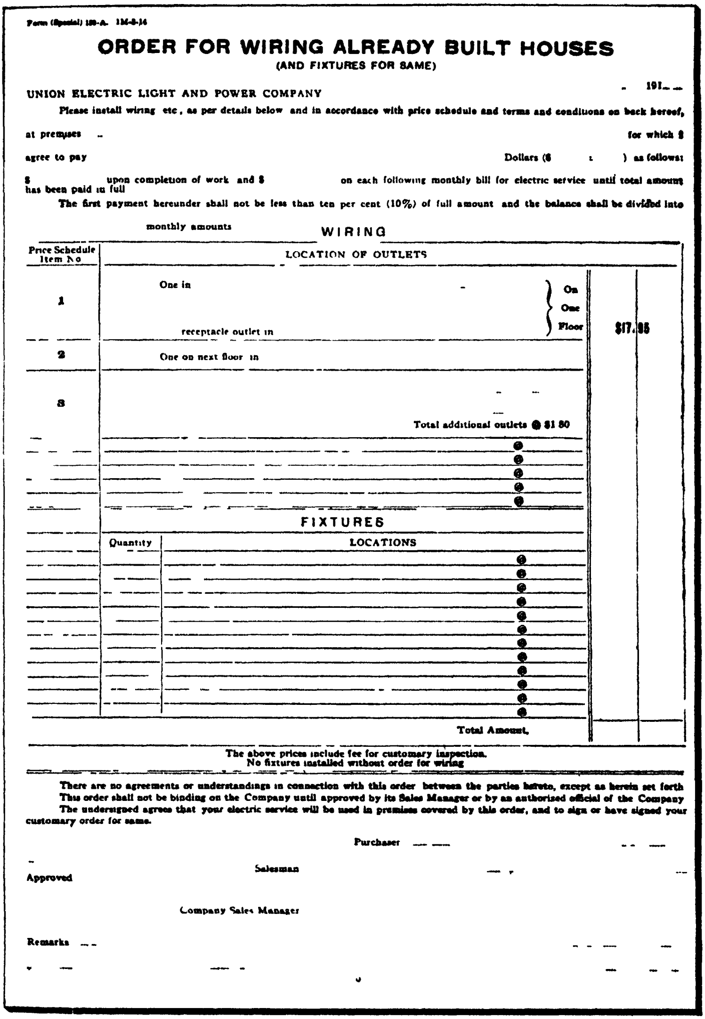
*Name*________________

*Address*________________

FIG. 8.—Back of return card from finished-building wiring circular.

27. In the Union Electric Company's circular a contract form is included. Fig. 9 shows one side and Fig. 10 shows the reverse. The company's proposition is thoroughly covered by the contract form. The consumer can fill in the form himself or the solicitor can do it for him. Including the contract form in the circular eliminates unnecessary clerical work and provides a means whereby the customer may know from the start the exact nature of the proposition that is presented for his consideration. An outline of the Union Electric Company's campaign is given in Par. **59**. The fixtures that are referred to on the contract are illustrated in Fig. 203.

28. The National Electric Light Association's Booklet "Electric Service in the Home." Its cover is shown in Fig. 11. It is furnished to member companies at a nominal price and is a splendid medium for popularizing the finished-building wiring proposition. It is written in an easy, popular style and is well illustrated with line cuts and half tones. It comprises 20 pages—



Form (Special) 180-A. 1M-8-14

ORDER FOR WIRING ALREADY BUILT HOUSES

(AND FIXTURES FOR SAME)

191

UNION ELECTRIC LIGHT AND POWER COMPANY

Please install wiring etc., as per details below and in accordance with price schedule and terms and conditions on back hereof,

at premises for which I

agree to pay Dollars ($) as follows:

$ upon completion of work and $ on each following monthly bill for electric service until total amount has been paid in full

The first payment hereunder shall not be less than ten per cent (10%) of full amount and the balance shall be divided into

monthly amounts

WIRING

Price Schedule Item No	LOCATION OF OUTLETS			
1	One in receptacle outlet in	On One Floor	$17.	85
2	One on next floor in			
3	Total additional outlets @ $1 80			
	@			
	@			
	@			
	@			
	@			

FIXTURES

Quantity	LOCATIONS		
	@		
	@		
	@		
	@		
	@		
	@		
	@		
	@		
	@		
	@		
	@		
	@		
	Total Amount,		

The above prices include fee for customary inspection.
No fixtures installed without order for wiring

There are no agreements or understandings in connection with this order between the parties hereto, except as herein set forth

This order shall not be binding on the Company until approved by its Sales Manager or by an authorized official of the Company

The undersigned agrees that your electric service will be used in premises covered by this order, and to sign or have signed your customary order for same.

Purchaser

Salesman

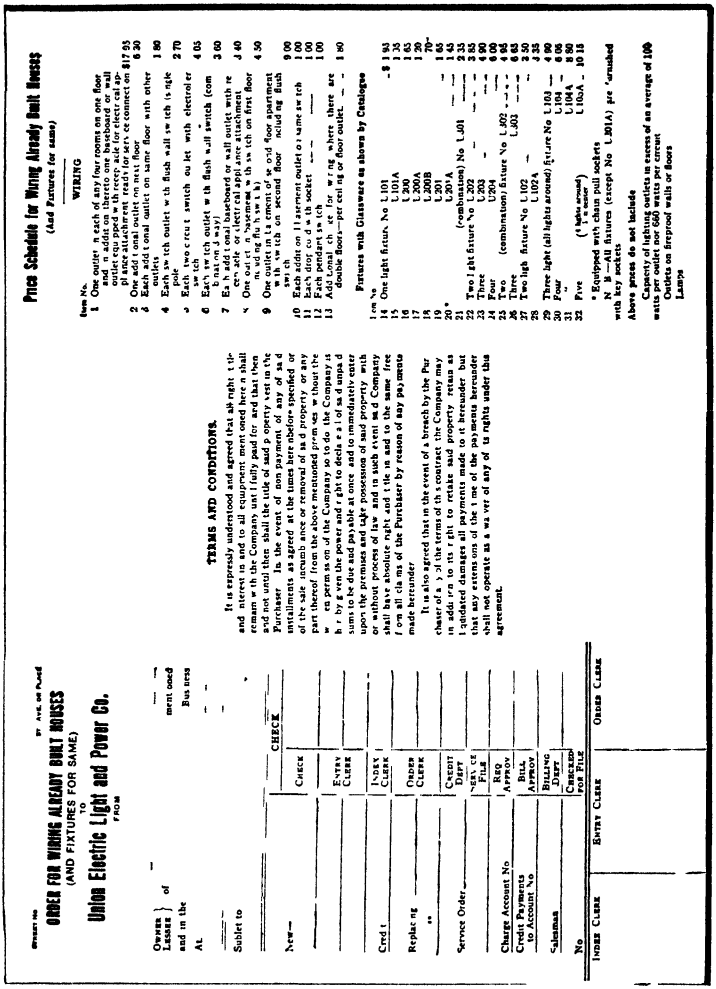
Approved

Company Sales Manager

Remarks

FIG. 9.—One side of finished-building wiring contract form.

coated paper—and cover. Spaces are provided for the imprint of the company sending it out. The three chapters or sections are headed: (1) *The Wiring of the Home*, (2) *The Lighting Equipment*, and (3) *Electrical Devices*. A sample copy can be obtained from the office of the Association at 29 West 39th Street, New York City.



STREET NO ST AVE. OR PLACE

ORDER FOR WIRING ALREADY BUILT HOUSES
(AND FIXTURES FOR SAME)
TO
Union Electric Light and Power Co.
FROM

Owner / Lessee } of ment oned
and in the Business
At

Sublet to

New—

Credit

Replacing
"

Service Order

Charge Account No

Credit Payments to Account No

Salesman

No

CHECK	
Check	
Entry Clerk	
Index Clerk	
Order Clerk	
Credit Dept	
Service File	
Req Approv	
Bill Approv	
Billing Dept	
Checked for File	

Index Clerk	Entry Clerk	Order Clerk

TERMS AND CONDITIONS.

It is expressly understood and agreed that all right title and interest in and to all equipment mentioned herein shall remain with the Company until fully paid for and that then and not until then shall the title of said property vest in the Purchaser In the event of non payment of any of said installments as agreed at the times hereinbefore specified or of the sale incumbrance or removal of said property or any part thereof from the above mentioned premises without the written permission of the Company so to do the Company is hereby given the power and right to declare all of said unpaid sums to be due and payable at once and to immediately enter upon the premises and take possession of said property with or without process of law and in such event said Company shall have absolute right and title in and to the same free from all claims of the Purchaser by reason of any payments made hereunder

It is also agreed that in the event of a breach by the Purchaser of any of the terms of this contract the Company may in addition to its right to retake said property retain as liquidated damages all payments made to it hereunder but that any extensions of the time of the payments hereunder shall not operate as a waiver of any of its rights under this agreement.

Price Schedule for Wiring Already Built Houses
(And Fixtures for same)

WIRING

Item No.		
1	One outlet in each of any four rooms on one floor and in addition thereto one baseboard or wall outlet equipped with receptacle for electrical appliance attachment ready for service connection	$17 95
2	One additional outlet on next floor	6 30
3	Each additional outlet on same floor with other outlets	1 80
4	Each switch outlet with flush wall switch (single pole	2 70
5	Each two circuit switch outlet with electrolier switch	4 05
6	Each switch outlet with flush wall switch (combination 3 way)	3 60
7	Each additional baseboard or wall outlet with receptacle for electrical appliance attachment	3 40
8	One outlet in basement with switch on first floor including flush switch)	4 50
9	One outlet in basement of second floor apartment with switch on second floor including flush switch	9 00
10	Each addition [illegible] basement outlet on same switch	1 00
11	Each drop cord with socket	1 00
12	Each pendant switch	1 00
13	Additional charge for wiring where there are double floors—per ceiling or floor outlet.	1 80

Fixtures with Glassware as shown by Catalogue

Item No			
14	One light fixture No	L 101	$ 1 93
15		L 101A	1 35
16		L 200	1 65
17		L 200A	1 20
18		L 200B	70
19		L 201	1 65
20 *		L 201A	1 45
21	(combination) No	L 301	2 35
22	Two light fixture No	L 202	3 85
23	Three	L 203	4 90
24	Four	U204	6 00
25	Two (combination) fixture No	L 302	4 95
26	Three	L 303	6 65
27	Two light fixture No	L 102	2 50
28		L 102A	3 35
29	Three light (all lights around) fixture No	L 103	4 90
30	Four	L 104	6 05
31	"	L 104A	8 80
32	Five (4 lights around / 1 in center)	L 105A	10 15

* Equipped with chain pull sockets

N B —All fixtures (except No L 201A) are furnished with key sockets

Above prices do not include

Capacity of lighting outlets in excess of an average of 100 watts per outlet nor 660 watts per circuit

Outlets on fireproof walls or floors

Lamps

FIG. 10.—Reverse side of finished-building wiring contract form.

29. Handbills can be used with good effect in small cities and towns. The larger places can be covered more effectively and at less expense through the newspapers. Handbills used for this purpose should always carry an attractive illustration or two—electrotypes can be obtained gratis from the large electrical manufacturing companies—otherwise they are likely to be thrown away before they are read. The text should be concise. The advantages of electric service may be very briefly outlined and then the central station's finished-building wiring proposition can be briefly stated. The company's telephone number should always be given so that the prospect may call for a solicitor with minimum effort.

30. Electric signs provide a splendid method of giving publicity to finished-building wiring propositions. The wording on them is necessarily brief. A phrase like "YOUR HOUSE WIRED AT COST, CALL MAIN 4280," or something similar, is about all that can be used on a stationary sign. With a flashing sign the possibilities are almost endless.

31. Personal canvass, although it is in one sense a means of advertising, is treated under the heading of *Soliciting* in other paragraphs.

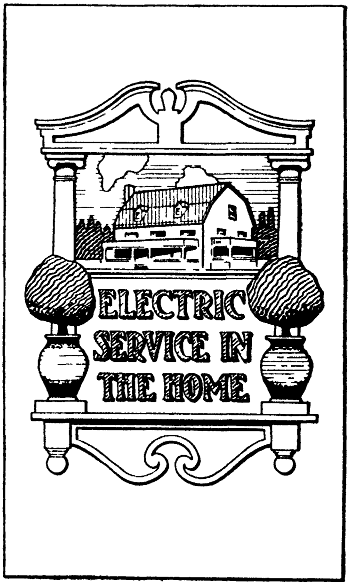
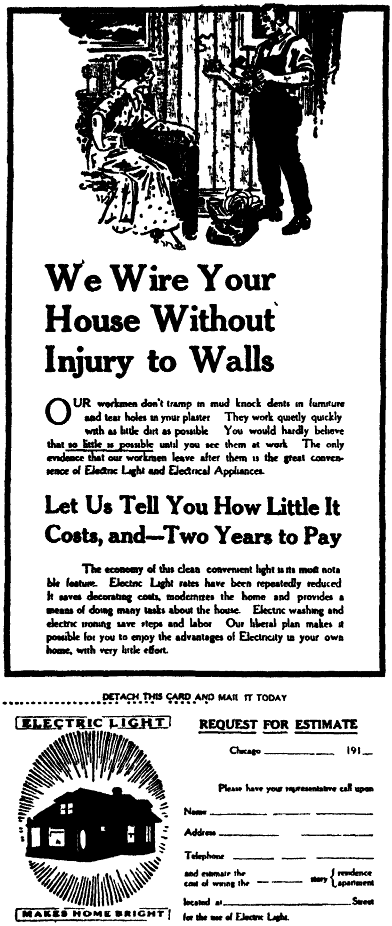


FIG. 11.—Cover of the National Electric Light Association booklet.

32. Electrical page advertising, in cities where the newspapers carry electrical pages, is conceded to be good publicity. The following notes are abstracted from the paper of J. E. McKirdy and Howard H. Wood on *The Wiring of Old Houses* read before the 1912 Convention of the Pennsylvania Electric Association:

The Electrical Page was introduced in Pittsburgh to the benefit of both newspapers and the electrical interests, during 1912. Such a page was published weekly in two papers which had a combined circulation of 180,000. Four of the seven columns of each of the pages were devoted to co-operative electrical advertising by the different electrical interests. The remaining three columns were devoted to electrical news items. The aim was to explain in an interesting way the advantages of every conceivable use for electricity. People looked forward to the appearance of the pages. It is believed that the Electrical Page provides the most effective medium available for educating the public as to the popular applications of electricity and the desirability of having buildings wired.


ELECTRIC LIGHT
MAKES HOME BRIGHT

We Wire Your House Without Injury to Walls

OUR workmen don't tramp in mud knock dents in furniture and tear holes in your plaster They work quietly quickly with as little dirt as possible You would hardly believe that so little is possible until you see them at work The only evidence that our workmen leave after them is the great convensence of Electric Light and Electrical Appliances.

Let Us Tell You How Little It Costs, and—Two Years to Pay

The economy of this clean convenient light is its most notable feature. Electric Light rates have been repeatedly reduced It saves decorating costs, modernizes the home and provides a means of doing many tasks about the house. Electric washing and electric ironing save steps and labor Our liberal plan makes it possible for you to enjoy the advantages of Electricity in your own home, with very little effort.

DETACH THIS CARD AND MAIL IT TODAY

REQUEST FOR ESTIMATE

Chicago ____________ 191__

Please have your representative call upon

Name ______________________

Address ______________________

Telephone ______________________

and estimate the cost of wiring the ________ story {residence / apartment

located at ______________________ Street

for the use of Electric Light.

FIG. 12.—Cover of folder of Faraday Electrical Association.

33. Advertising by Local Contractors' Associations. In certain instances contractors' associations have advertised co-operatively. It is obvious that it would not be feasible for any but the largest contractors to advertise a finished-building wiring campaign effectively. However, when their efforts are united, resultful advertising is possible. An example of such advertising was that of the Faraday Electrical Association of Chicago. Fig. 12 shows the cover of a folder of that Association which was mailed by the member contractors to prospective consumers. At the bottom there is a detachable post card. On this, requests for additional information and for estimates can be made. On the reverse side is given the name and address of the contractor sending out the circular. Fig. 13 shows a notice that was included in the circular.

34. Blind advertising was employed during a Pittsburgh, Pa., campaign. It was started early in the spring, before the moving-day period, with the idea of educating the tenants to demand from the prospective landlord that he wire the house before they moved in. A special incoming-call telephone having an easily remembered number was installed by the Company in its office to handle the inquiries. All employees in the wiring and contracting departments were instructed as to the details of the proposed campaign. A "want advertisement," reading thus, "*Don't rent a house unless it is wired for electricity. Call* 898 *Hiland for information*" (Fig. 14), was inserted in the classified columns of all of the important daily newspapers under the headings: "HOUSES AND APARTMENTS TO LET" and "HOUSES FOR SALE." Irate landlords and agents called the company demanding that the advertising be stopped, which was an indication of its effectiveness. It was continued for thirty days longer than was originally contemplated.

It Surprises Nearly Everyone

To Know How Little Fuss or Muss Our Workmen Make When Wiring Houses for the Use of Electric Light

Almost anybody can run wires. Putting them back of tinted walls without marring the plaster—under polished floors without leaving a trace of the work—is another thing. Our workmen have demonstrated their ability to do this many times. They are not experimenting on your house.

All Work Guaranteed by This Association

We Wire Your House----Two Years to Pay

FIG. 13.—Advertising notice of Faraday Electrical Association.

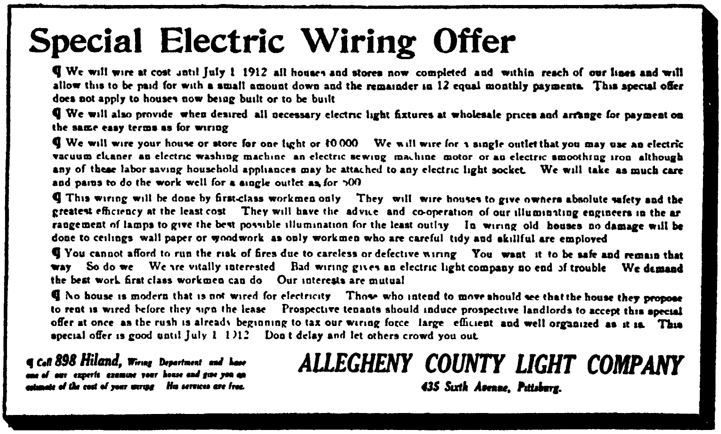
Don't

Rent a house unless it is wired for Electricity.

¶ Call 898 Hiland for information.

FIG. 14.—An advertisement that converted prospective customers into lighting company solicitors.

35. Advertising Methods of the Byllesby Company. The campaign was opened with the simultaneous appearance of full-page display advertisements in the newspapers of all the cities in which the company had central stations. These announced in bold type, "HOMES WIRED FOR ELECTRIC LIGHT AT ACTUAL COST—WE PAY THE CONTRACTOR'S PROFITS." Below this, three wiring propositions (**104**) were offered the householder, with the assurance that all the installations would be completed in a safe and thoroughly modern way and that no householder would be required to sign a contract for electric current.



Special Electric Wiring Offer

¶ We will wire at cost until July 1 1912 all houses and stores now completed and within reach of our lines and will allow this to be paid for with a small amount down and the remainder in 12 equal monthly payments. This special offer does not apply to houses now being built or to be built

¶ We will also provide when desired all necessary electric light fixtures at wholesale prices and arrange for payment on the same easy terms as for wiring

¶ We will wire your house or store for one light or 10 000 We will wire for a single outlet that you may use an electric vacuum cleaner an electric washing machine an electric sewing machine motor or an electric smoothing iron although any of these labor saving household appliances may be attached to any electric light socket. We will take as much care and pains to do the work well for a single outlet as for 500

¶ This wiring will be done by first-class workmen only They will wire houses to give owners absolute safety and the greatest efficiency at the least cost They will have the advice and co-operation of our illuminating engineers in the arrangement of lamps to give the best possible illumination for the least outlay In wiring old houses no damage will be done to ceilings wall paper or woodwork as only workmen who are careful tidy and skillful are employed

¶ You cannot afford to run the risk of fires due to careless or defective wiring You want it to be safe and remain that way So do we We are vitally interested Bad wiring gives an electric light company no end of trouble We demand the best work first class workmen can do Our interests are mutual

¶ No house is modern that is not wired for electricity Those who intend to move should see that the house they propose to rent is wired before they sign the lease Prospective tenants should induce prospective landlords to accept this special offer at once as the rush is already beginning to tax our wiring force large efficient and well organized as it is. This special offer is good until July 1 1912 Don t delay and let others crowd you out.

¶ *Call 898 Hiland, Wiring Department and have one of our experts examine your house and give you an estimate of the cost of your wiring His services are free.*

ALLEGHENY COUNTY LIGHT COMPANY

435 Sixth Avenue, Pittsburg.

Seven Columns by Ten Inches

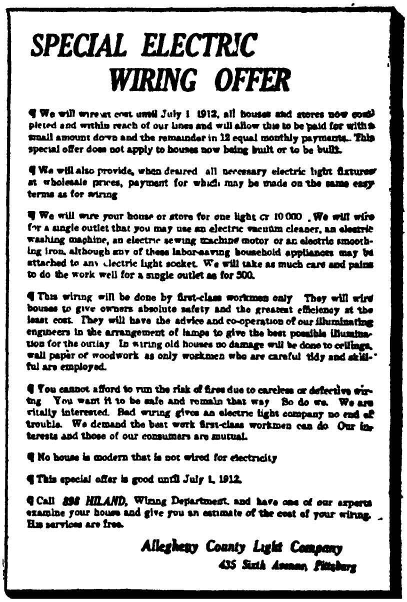
FIG. 15.—Advertisement used in opening the Pittsburgh Campaign. (Since this advertisement was printed the name of the company has been changed to The Duquesne Light Co.)

The full-page advertisement was repeated several times and was then followed by a series of smaller display advertisements. The final advertisement set a short time limit before which the owners of unwired buildings might take advantage of the offer. The advertisements, meanwhile, were followed up by solicitors who explained the proposition in detail and closed contracts wherever possible.

36. An example of a successful advertising campaign is that which was conducted by The Duquesne Light Company of Pittsburgh. It was considered that the only method whereby the potential business in the territory could be connected was through the inauguration of a campaign for the wiring of finished buildings.

The company had maintained a wiring department for several years, but it is only within the last few years that it has made an organized effort to wire finished buildings through systematic advertising. The campaign started on January 1, 1911.

Blind advertising as described in Par. **34** was the first move. After this device had aroused the interest of renters and property owners, half-page advertisements, an example of which is given in Fig. 15, were used. The advertisements announced that buildings would be wired at cost if estimates were requested before July 1. The time limit was set to accelerate the placing of the contracts. The closing date was extended later with the proviso that the estimate be requested before September 1 and the contract for the wiring be placed before October 1.



SPECIAL ELECTRIC WIRING OFFER

¶ We will wire at cost until July 1 1912, all houses and stores now completed and within reach of our lines and will allow this to be paid for with a small amount down and the remainder in 12 equal monthly payments. This special offer does not apply to houses now being built or to be built.

¶ We will also provide, when desired all necessary electric light fixtures at wholesale prices, payment for which may be made on the same easy terms as for wiring

¶ We will wire your house or store for one light or 10 000 . We will wire for a single outlet that you may use an electric vacuum cleaner, an electric washing machine, an electric sewing machine motor or an electric smoothing iron, although any of these labor-saving household appliances may be attached to any electric light socket. We will take as much care and pains to do the work well for a single outlet as for 500.

¶ This wiring will be done by first-class workmen only They will wire houses to give owners absolute safety and the greatest efficiency at the least cost. They will have the advice and co-operation of our illuminating engineers in the arrangement of lamps to give the best possible illumination for the outlay In wiring old houses no damage will be done to ceilings, wall paper or woodwork as only workmen who are careful tidy and skillful are employed.

¶ You cannot afford to run the risk of fires due to careless or defective wiring You want it to be safe and remain that way So do we. We are vitally interested. Bad wiring gives an electric light company no end of trouble. We demand the best work first-class workmen can do Our interests and those of our consumers are mutual.

¶ No house is modern that is not wired for electricity

¶ This special offer is good until *July 1, 1912.*

¶ Call ***898 HILAND,*** Wiring Department, and have one of our experts examine your house and give you an estimate of the cost of your wiring. His services are free.

Allegheny County Light Company
435 Sixth Avenue, Pittsburg

Three Columns by Ten Inches.

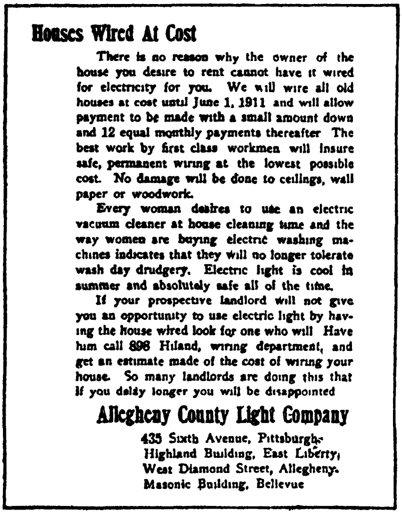
FIG. 16.—One of the smaller advertisements used after the campaign was well launched. (Since this advertisement was printed the name of the company has been changed to The Duquesne Light Company.)

In the advertising, attention was directed to the facts that the buildings and furnishings would not be visibly injured; that safe wiring would be installed; that an estimate would be furnished free, and that the wiring could be paid for on the installment plan.

As the campaign progressed, the size of the advertisements was decreased. Figs. 16 and 17 show two of the smaller ones. The so-called "GOING, GOING, GONE" advertisement was the grand finale of the Pittsburgh advertising campaign. Prominent in the advertisement was the picture of an auctioneer, hammer in hand, ready to knock down the prize—in this case a wiring contract.

From his mouth came the headlines calling attention to the fact that only so many days remained during which the householder might take advantage of the "*golden opportunity*" of having his house wired at cost.

At times the display advertisements were discontinued and practically the same wording was used in local reading notices (Fig. 17). The "Going, Going, Gone" theme was introduced ten days before the close of the campaign. As an additional stimulant posters were used on the dashboards of street cars.



Houses Wired At Cost

There is no reason why the owner of the house you desire to rent cannot have it wired for electricity for you. We will wire all old houses at cost until June 1, 1911 and will allow payment to be made with a small amount down and 12 equal monthly payments thereafter The best work by first class workmen will insure safe, permanent wiring at the lowest possible cost. No damage will be done to ceilings, wall paper or woodwork.

Every woman desires to use an electric vacuum cleaner at house cleaning time and the way women are buying electric washing machines indicates that they will no longer tolerate wash day drudgery. Electric light is cool in summer and absolutely safe all of the time.

If your prospective landlord will not give you an opportunity to use electric light by having the house wired look for one who will Have him call 898 Hiland, wiring department, and get an estimate made of the cost of wiring your house. So many landlords are doing this that if you delay longer you will be disappointed

Allegheny County Light Company

435 Sixth Avenue, Pittsburgh.
Highland Building, East Liberty,
West Diamond Street, Allegheny.
Masonic Building, Bellevue

FIG. 17.—Effective reading notice. (Since this advertisement was printed the name of the company has been changed to The Duquesne Light Company.)

As to results: The response to the advertising was instantaneous, and the astonishing number of inquiries that were received made it plain that finished-building wiring at moderate cost was a long-felt want. There were forty inquiries the first day of the insertion of an advertisement in only one newspaper. A single request for an estimate often resulted in the securing of a number of contracts. Many people, however, delayed requesting estimates until the offer was about to be withdrawn. During the last ten days preceding the time limit the inquiries increased daily until in one day ninety-seven property owners requested estimates, the total for ten days being over six hundred. Three telephones were required to handle the business and it was necessary to keep the wiring department open each evening until 10 o'clock.

CHAPTER III

SOLICITATION

37. Men of two classes, estimator-solicitors and salesman-solicitors, have been used to seek finished-building wiring business. On the whole the salesman-solicitor has been the most successful for reasons outlined in another paragraph. The estimator-solicitor should be a wireman capable of compiling detail estimates. Detail estimates are only necessary when prices are made on a detail estimate basis or where the price for a wiring proposition, that is not covered by standard price schedules, is required.

38. An expert estimator is seldom a good salesman. The converse is also true. It is for this reason that it has been found generally desirable to provide simple unit-price schedules. With these the non-technical solicitor can easily compute his prices—or the prospective consumer can compute them—with the consumption of very little time. Most of the solicitor's time will thus be available for his real work, that of getting the business.

39. Qualifications of the Finished-building Wiring Solicitor. It is more essential that he be a good salesman than a man thoroughly versed in the applications of electricity. He should be capable of addressing people of all sorts and of explaining to them the advantages and comforts that result from having a house wired. If a schedule of standardized prices, that has been compiled on the basis thoroughly discussed in another chapter, is adopted, the solicitor will have no difficulty in computing his quotations. Experience has shown that men who have the knack of selling will accumulate enough electrical knowledge in a week or so of field experience to enable them—provided they are equipped with the proper price schedules—to do very effective work. While a detail knowledge of electric wiring is sometimes advantageous, more frequently it is not. A solicitor who has this knowledge is apt to discuss with the prospective customer technicalities that will confuse. Very large or exceptionally intricate jobs which should and do call for a detail estimate should be referred by the solicitor to the department head, who can enlist the services of a wireman-estimator. The solicitor, ordinarily, should figure only on the average run of jobs, the prices for which can be readily computed from the standard schedule. A very large proportion—nearly all—of the finished-building installations will fall within this class.

40. Division of a Community into Solicitation Districts. Each solicitor should be assigned his own district. In a small town the entire town would be the solicitor's territory. Where two solicitors are employed, the community to be canvassed should be divided into two districts. Each man should be responsible for his own district and should handle all inquiries emanating from it. Larger cities should be divided into as many districts as there are solicitors. Each man working only in his own district becomes acquainted with its people and its characteristics. This constitutes a valuable asset.

41. The solicitor should call on the occupant and on the owner of every unwired building in his territory. It is not often feasible to make the territories sufficiently small that this can be done. But it has been done and successfully. In certain campaigns card records (see following paragraph) have been compiled for practically all of the unwired buildings in the territory served. The potential prospects indicated by these cards have been and will be persistently followed up until all of the possible business is secured.

42. A card record of unwired buildings should be accumulated in any serious campaign. The solicitor when he calls—and he should call at every unwired building in his territory—secures the information whereby the record card can be filled in, or he fills it in himself at the premises. Some companies prefer typewritten records in which case the solicitor provides his office with a pencil memorandum of the data necessary for the record. (See Par. **63** for a description of the method used by the Kansas City Company for accumulating a record of unwired buildings.) Fig. 18 shows a soliciting card which has many valuable features. It is used by the Werdan, Saxony, central station and is described in Mr. Doane's *N.E.L.A.* report.

Each building in the city and surrounding villages has an 8-in. × 5-in. card like that of Fig. 18. The first ten semicircular projections at the left of the top of the card indicate the vocations of those occupying the houses. The ten right-hand projections show the initials of the street names. After the card is filled out, all of the semicircular projections that do not apply to the one

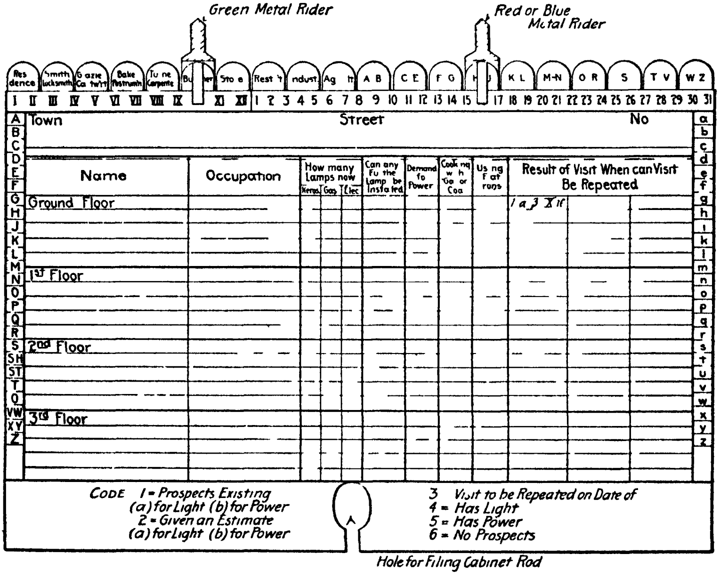


FIG. 18.—Example of a soliciting card

building which the card records are cut off prior to its filing. Thus the record cards are self-indexing. All cards for streets beginning with "*S*" or all cards for "*Residences*" or for "*Bakers*" can be separated from the balance in the file with little difficulty. At the left of the card below the projections there is a row of twelve Roman numerals each of which indicates a month. The row of thirty-one Arabic numerals just to the right indicates days of the month.

Spaces are provided for writing in the name of the town and addresses. The four horizontal divisions of the table are for information relating to the occupants in the different apartments and on the different floors of the building. The code printed at the bottom of the card is used for filling the last three columns headed "RESULT OF VISIT, WHEN CAN VISIT BE REPEATED." For example: if there were *Prospects Existing* for *Light* and the *Visit to be Repeated on Date of* Oct. 16, the code "1–*a*–3–*X*16" would be entered in the column as shown. Also a green rider is slipped over the numeral *X* indicating the month of October and a red rider or a blue one is slipped over the numeral 16, indicating the day of the month. The red riders are used for ordinary prospects and the blue ones for important large-load prospects that should be watched closely. The vertical columns of letters along the extreme right and left edges indicate the first and last letters of the name of the village.

When a solicitor starts on his rounds he takes with him the cards for as many streets as he thinks he can cover within a stipulated time. He proceeds systematically from house to house. The entries on the cards are in pencil so that they can be readily altered. A receipt is required from each solicitor for the cards that he takes from the file.

43. Advantages of Carrying a Simple Wiring Price Schedule. The psychological advantage of showing the prospect upon the first visit to his home approximately what it will cost to wire the building cannot be overestimated. The simplicity, speed and satisfaction of such a transaction is in marked contrast to the usual delay of summoning an experienced wireman to inspect the home, estimate the cost at the company's office and submitting the bid to the prospective customer by mail. The enthusiasm incident to the solicitor's first visit often dies away before the final bid is submitted and the owner may alter his intentions. With cost-table in his hand, the solicitor upon learning what outlets and switches the householder desires installed can quickly compute the price of the installation, inform the owner and often bring the first conference to a close with a signed contract in his pocket.

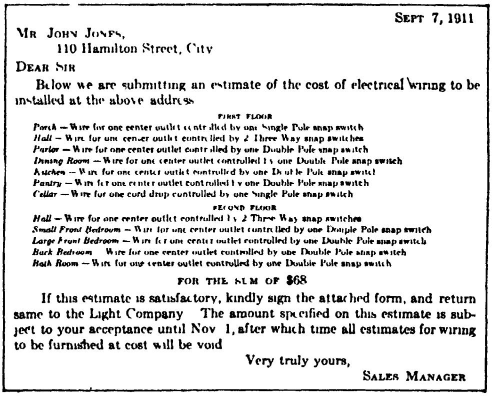
44. Description of an Estimating Blank and Its Use. The form of agreement entered into between householder and contractor during the Cleveland campaign contained a blank on the horizontal lines of which appeared the location and description of the various rooms to be wired, while vertical columns were provided for notations as to the types and number of fixtures and switches. By entering check marks in these spaces the solicitor was able to compute the required outlets quickly and had a simple record of the location of each. Figs. 20 and 21 (Par. **73**) show estimating blanks somewhat similar to that described above.

45. Estimators are sometimes necessarily employed in soliciting business of certain classes. This subject is also referred to in another paragraph. Some companies have, and with considerable success, compiled detail estimates for every job in which case each estimator frequently did his own soliciting. In other cases both a salesman and an estimator called on the prospective customer. Estimators are also usually required in communities where an aggressive campaign is not being promoted because in such cases no standardized price schedule ordinarily exists. In such instances, where only one man may be required, it is frequently possible to train a good salesman into a fairly good estimator.

46. Personal Requirements of the Estimator. A man who is to make an item-by-item estimate should have an intimate knowledge both of the mechanics of finished-house wiring and of the materials used. He will have little time left to present selling arguments to the householder and should therefore be preceded by a soliciting specialist. As elsewhere suggested, salesmen are not as a rule experienced wiremen nor are technical wiremen good salesmen. The ideal arrangement is to put the wireman's technical information in condensed form so that the salesman can carry it with him in soliciting orders.

47. The Estimator's Work in a Finished-building Wiring Campaign.—When an inquiry is received requesting an estimate on the cost of wiring an old building, an estimator is sent to interview the prospective customer. He surveys the work with the prospect, making suggestions as to locations of fixture and switch outlets and endeavors to plan a first-class installation and one that is within the means of the owner. When the number and locations of the outlets are determined the estimator, from notes taken in the building under consideration, fills in a blank estimate form, which is so prepared that it makes a full record of the job from start to finish. The estimator then prepares a detailed estimate for presentation to the owner, showing just what the company proposes to do and exactly how much the total work will cost. These estimates, an example of which is shown in Fig. 19, should be typewritten in duplicate. One is mailed or is presented to the prospect by a salesman and the other is filed.

48. Finished-building Wiremen as Electrical-goods Solicitors. It was found during the campaign in Pittsburgh that old-building wiremen are excellent solicitors for the installation of auxiliary electrical apparatus. The men work in a house for several days and are very likely to become acquainted with the occupants.



SEPT 7, 1911

MR JOHN JONES,
110 Hamilton Street, City

DEAR SIR

Below we are submitting an estimate of the cost of electrical wiring to be installed at the above address

FIRST FLOOR

Porch — Wire for one center outlet controlled by one Single Pole snap switch
Hall — Wire for one center outlet controlled by 2 Three Way snap switches
Parlor — Wire for one center outlet controlled by one Double Pole snap switch
Dining Room — Wire for one center outlet controlled by one Double Pole snap switch
Kitchen — Wire for one center outlet controlled by one Double Pole snap switch
Pantry — Wire for one center outlet controlled by one Double Pole snap switch
Cellar — Wire for one cord drop controlled by one Single Pole snap switch

SECOND FLOOR

Hall — Wire for one center outlet controlled by 2 Three Way snap switches
Small Front Bedroom — Wire for one center outlet controlled by one Douple Pole snap switch
Large Front Bedroom — Wire for one center outlet controlled by one Double Pole snap switch
Back Bedroom Wire for one center outlet controlled by one Double Pole snap switch
Bath Room — Wire for one center outlet controlled by one Double Pole snap switch

FOR THE SUM OF $68

If this estimate is satisfactory, kindly sign the attached form, and return same to the Light Company The amount specified on this estimate is subject to your acceptance until Nov 1, after which time all estimates for wiring to be furnished at cost will be void

Very truly yours,
SALES MANAGER

FIG. 19.—Typical proposal.

The wiremen often have opportunities to explain the convenience and economy of energy-consuming devices such as vacuum cleaners, fans, washing machines and electric irons. Considerable business resulted from their efforts. In certain successful instances premiums and cash prizes have been offered wiremen for securing business of this nature.

49. Methods of Solicitation in Germany. Personal canvassing is considered the most effective means of advertising. It has been found important in soliciting the small man's business, especially in the country, that the prospective customer finds in the solicitor a man of about his own education and possessing his own ways of thinking and talking. Consequently the solicitors are mostly chosen from the staff of wiremen, such men being selected as have shown a certain gift of speech and ability for handling men. These wiremen go out with their uniform caps and talk in Low-German dialect to the customers, thereby obtaining a better hearing from the latter. (S. E. Doane, *Electrical World*, May 23, 1914.)

50. Cash Premiums as a Stimulant to Solicitors (*Electrical World*, July 11, 1914). By giving each month prizes of an amount less than the salary of one salesman working on the house-wiring campaign the Louisville Gas & Electric Company was able to secure better results with five salesmen than were previously obtained with eight. These solicitors are restricted to making contracts for the wiring of finished buildings.

The principal prize is $10 in cash for what is termed "efficiency." The number of calls made by the salesman do not figure in this. The winner is determined by (1) *the amount of business he gets*, computed in terms of kilowatt hours, (2) *the amount of overtime he puts in*, (3) *the neatness of his reports*, (4) *his promptness in reporting*, and (5) *the absence of mistakes in his contracts*. Record is kept on a blackboard in plain view of all the employees in the office so that each man may know each day just where he stands with respect to the other solicitors. In addition $10 is given in weekly prizes. Only the volume of business turned in during the week by the men is figured in the award of these weekly prizes. The man who gets the most business receives the $6 prize and the man next to him gets $4. It was found that this method of stimulating salesmen did more to increase their effectiveness than any plan previously tried.

CHAPTER IV

POLICIES

51. Definite policies should be adopted prior to the inauguration of a finished-building wiring campaign. The central station should determine in advance just what its stand will be on certain features that recur in every campaign so that its entire procedure will be consistent and so that its advertising and solicitation policies will be in harmony with the general plan. Questions of a local character are likely to arise during every campaign. Concerning these there may be no precedents by which one may be guided. But the "recurring" questions have been decided one way or the other so many times that experience has indicated the best solutions for the average cases. The questions that will be classed here as recurring are: (1) *Method of Payment*, (2) *Relations with Contractors*, (3) *Basis of Prices*, (4) *The Matter of Fixtures*, and (5) *The Matter of Lamps*. Each of these items will be briefly discussed in paragraphs that follow. Their solutions in specific cases will be found in paragraphs in the chapter "*Examples of Campaigns*," and in other sections of the book. (See the Index.)

52. Methods of Payment. It has been the almost universal experience that, for a successful finished-building wiring campaign, the central station must arrange a means of financing whereby the consumer can, if he so chooses, pay for his wiring on the installment plan. Appropriations must be made to provide for this financing. If the central station does the wiring, the consumer makes an initial payment of possibly 20 per cent. (see Par. **67**, Muncie campaign), and the balance is paid in equal monthly installments extending over a year, more or less. If contractors are co-operating with the central station and do the work, it is the usual practice for the company to pay the contractor cash in full upon the acceptance of the job. The company then assumes the account and the consumer makes his installment payments on about the basis outlined above. Where a consumer does desire to pay cash he should be allowed a discount, say of 5 per cent. The discount for cash should not be too great, however, because if it is the consumer may show a tendency to procrastinate until he has sufficient ready money to make the cash payment. This is undesirable because the economical and satisfactory procedure is to complete each prospect's proposition with as few interviews and estimates as possible.

There is one surprising and gratifying circumstance in connection with this matter of installment payments. It is that, usually, a majority of the installment wiring accounts are liquidated in three or four months, whereas the consumers may have a year in which to pay. (See Par. **63,** *Kansas City Campaign* and Par. **69,** *Marshalltown, Iowa, Campaign.*) The bill for the installment wiring payment is usually added as an item on the regular monthly bill for electricity.

53. Relations with Contractors. It has been found in many instances that the most satisfactory arrangement is for the central station and the contractors to co-operate rather than to compete with one another in the wiring of finished buildings. Some central stations have had and now have wiring departments that do finished-building work at prices that admit of little or no profit, particularly if the important matter of general expense (see Par. **83**) is given consideration. In other cities, finished-building wiring departments are maintained by the central stations merely to handle special, unusually intricate jobs that the contractors cannot handle except at prohibitive prices. The central station's men, who do nothing but finished-building work, become so skillful at it that they can, when necessary, make a difficult wiring installation at considerably less cost than can the contractor who handles a general run of work.

It appears to be the general opinion among those best informed that the most effective system of handling finished-building wiring is (1) for the central station to agree, with the local contractors' association or with a group of contractors, upon a standardized price schedule (see Par. **75**) for wiring; (2) the central station solicits the wiring business on the basis of the standardized schedule assuming all solicitation and advertising expense; (3) the central station apportions equitably the business thus obtained among the contractors with whom it is co-operating; (4) the central station pays the contractor the standardized price upon the completion and acceptance of the job, and (5) the central station assumes the account, as hereinbefore explained, and receives the payments for it on the installment plan, if the consumer so desires.

Experience has shown that business can be obtained at prices that are sufficiently high as to allow a fair profit for the contractor. It is therefore generally unwise for a central station to embark in a house-wiring business unless the contractors demand unreasonable profits. The contractors can give material assistance to the central stations and for this reason, even if the ethical considerations of the situation are disregarded, they should not be antagonized.

In apportioning wiring contracts obtained by central-station solicitors among the co-operating contractors, the strictest fairness should be observed. Usually, the contractors are assigned the contracts in rotation as they are turned in to the central station. In other cases (see Par. **59c,** St. Louis Campaign) it has appeared more equitable to assign each contractor, in sequence, $100 worth of work. In Muncie, Ind. (Par. **67**), it was agreed that the company could award a number of contracts, not to exceed ten, for jobs all in one vicinity, to one contractor. However, every other contractor was to receive an equal amount of business before the first man received more.

In compiling a standardized wiring schedule the prices should be sufficiently high that it is certain that it includes ample profit for the contractors. Then if it is found possible, after a number of installations have been made, the prices can be reduced.

Contractors sometimes contend that unit prices are not fair to them because, on a unit-price basis, they may profit on one job and lose on another. If the contractor will consider the average profit, that is, the profit on, say, all of the jobs for a month and not consider individual jobs, this possible objection will disappear.

54. How One Central Station Company Co-operates with the Contractors. For many years the Company offered propositions whereby finished buildings could be wired for electricity and the payments therefor could be made in installments. The payments were extended over a two-year term and were included in the consumer's monthly bills. An arrangement was made whereby similar wiring could be done by contractors that are members of the local Electrical Association under the same terms as those offered by the Company to the consumer direct. The Company's price schedules are used by these contractors. The company pays the contractor cash upon the completion of a job and collects the monthly installments from its customer. In the material on *Advertising* the methods of publicity that have been used by the Contractors' Associations are explained. The prices of a standardized schedule should allow a fair profit to the contractor. The relations between the company and the contractors should be frictionless. A great deal of finished-building wiring work has been secured by contractors when new-building work was particularly dull.

55. Estimating and Prices. (See Pars. starting with **71.**) Some companies still make a detail time and material estimate for each job. The prevailing opinion, however, appears to be that by far the most successful and satisfactory method is to use, where possible, standardized price schedules so that every one—consumer, solicitor, contractor, and all others that are interested—can make a price for an installation without calling in any other person.

The question as to whether it is better to adopt a flat rate per job or a unit price per outlet schedule is discussed in Par. **76** and in those that follow. Some central stations have found it desirable (see **102**, St. Louis, and **105**, Boston) to market a minimum wiring installation which automatically promotes a demand on the consumer's part for additional outlets. Standardized price schedules are of little value for store and factory wiring. Time and material estimates should be made for work of this class and for all other work of an unusual character.

56. Policy in Regard to Fixtures. (See chapter on "*Fixtures.*") Some companies arrange to furnish fixtures for their wiring installations and some do not. High-class fixtures—sometimes special designs—are usually necessary for fine residences, and it is in most cases best to suggest that the consumer arrange to purchase these through some established fixture concern or jobbing house. For the home of the person of moderate income, fixtures of standard design that are produced in large quantities by the manufacturers are very acceptable. They can be purchased or contracted for in quantities by the central station and resold to the consumer at low prices. It is the general experience that the finished-building wiring contracts can be obtained more readily if fixtures are included. The average consumer desires a complete installation and likes to feel that the central station will stand back of it all. It is well to adopt designs, like those of Fig. 202, that can be readily duplicated by any fixture manufacturer.

56a. Solicitors should carry pictures and prices of fixtures and thereby be equipped to give prospective customers prices on installations complete with fixtures. It is assumed that every solicitor carries a price schedule whereby he can give prices on the wiring end of the installation. (See chapter on "*Solicitation.*")

56b. Free Fixtures as a Feature of a Finished-building Wiring Campaign. The Manchester, N. H., Traction Light & Power Co. conducted a successful wiring campaign with the co-operation of the real estate dealers and wiring contractors. Throughout the campaign, which lasted a month, the company furnished free fixtures for any house within its service zone. Private contractors were instructed by the company to install wiring on this basis, the company meeting the fixture cost. The prospective user of electricity was given the choice of several fixture designs.

56c. Rental of Fixtures in Europe. (S. E. Doane in 1914, *N. E. L. A. Report.*) At Werdan, Saxony, the wiring is installed at the expense of the central station, if the customer so desires. In that case he pays a supplementary charge of 3.6 cents a lamp a month as rent for the installation, which includes simple fixtures but not lamps. The consumer also must contract to continue these payments for at least three years. This amount of 3.6 cents a month is based on the assumption that 15 per cent. of the average selling price of the installation shall be paid off every year by the rent. The average selling price has, therefore, been assumed as being $2.90 a lamp outlet. Flexible twin cord is chiefly used in wiring these outlets.

Several years ago the municipal plant at Dortmund discovered that there were a number of residences in the city which, though wired, were not connected to its lines. In the city, which has 150,000 inhabitants, 700 wired houses in laborers' quarters were not receiving service. The reason given ordinarily was that electricity was "too expensive," but it was found that the real reason was that the tenants were not willing to incur the expense of installing electric fixtures. The lighting company resolved to rent electric fixtures as the local gas company had already been doing with gas fixtures. Thirteen different types of fixtures are being rented at prices ranging from 4 cents, for simple ceiling fixtures with enamel reflectors, to 72 cents per month for elaborate chandeliers for four lamps. The price for installing is 48 cents. After the rent has been paid for three successive years, the tenant acquires ownership. The payments which are designated by the company as rent are actually installment payments. To prevent dissatisfaction among the contractors, the rents are fixed high enough so that a three years' rent amounts to the list price of the fixture, the list prices being, moreover, so high that discounts of from 60 per cent. to 70 per cent. are ordinarily given.

About three and one-half years after the system had been introduced, rental contracts for 11,300 fixtures had been made, of which 5500 were contracted for in the last year alone. It was possible to fulfill these 11,300 contracts with a supply of only 10,500 fixtures, since a certain number had been returned to the company before the expiration of the three years in cases where the tenants moved out of town. These returned fixtures were polished (and, if necessary, repaired) and rented a second time.

57. Policy in regard to furnishing lamps for finished-building wiring installations. There appears to be no established practice. However, it has, apparently, been found desirable to include lamps in the flat prices for complete installations for small residences (see Par. **104,** Mobile). It appears that the small-home owner prefers to have the price that is given him include everything that is required, complete and ready to furnish light. If any item is omitted he may become suspicious and desire to procrastinate.

57a. The controlled-flat-rate method of charging in connection with finished-building wiring campaigns[1] appears to attract business that cannot be obtained by other means. A flat rate of 1 cent per watt per month is usually adopted in this country. The minimum monthly charge is usually $1. A *current-limiting device, excess indicator* or *flat-rate controller* is installed in each consumer's residence to prevent the consumer from using more than the maximum current to which he is entitled. If his load exceeds the demand for which his excess indicator is set, the device will interrupt the circuit periodically, causing the lamps to wink until the load is reduced to within the value for which the device has been adjusted. The Excess Indicator Company of Pittsburgh manufactures such instruments. They cost in this country from $7.50 to $4.50, depending on the quantity furnished. In Europe they are much cheaper.

The current-limiters cost much less than watt-hour meters—and with the limiters, meter reading is eliminated and the cost of accounting is minimized. Hence with these instruments and with low-cost wiring, it is possible for the central station to seek and serve with profit even the smallest consumers. Experience shows that a large proportion of these flat-rate consumers ultimately change over to a meter basis, hence the method is very effective in introducing and popularizing central-station service. Meter customers seldom, if ever, desire to change to a flat-rate basis. The net revenue per kilowatt hour is usually almost exactly the same with flat-rate as with meter customers. If there is any difference, it is probable that the flat-rate customers will be the most profitable. The gross revenue from controlled-flat-rate consumers averages about 9¢ per kw-hr.

The controlled-flat-rate method of charging has been very successful in attracting the minor consumers in Europe; see S. E. Doane's paper (Par. **171**): "*The Successful Handling of the Small Customer in Europe.*" In the United States, this method of charging has been successfully used in conjunction with finished-building wiring campaigns in: Pittsburgh, Pa.; Hartford, Conn.; Scranton, Pa.; Harrisburg, Pa.; Muncie, Ind., Par. **67**, and South Bend, Ind., Par. **66a.**

[1] A. T. Holbrook, *Electrical Review*, Oct. 3, 1914, page 674.

CHAPTER V

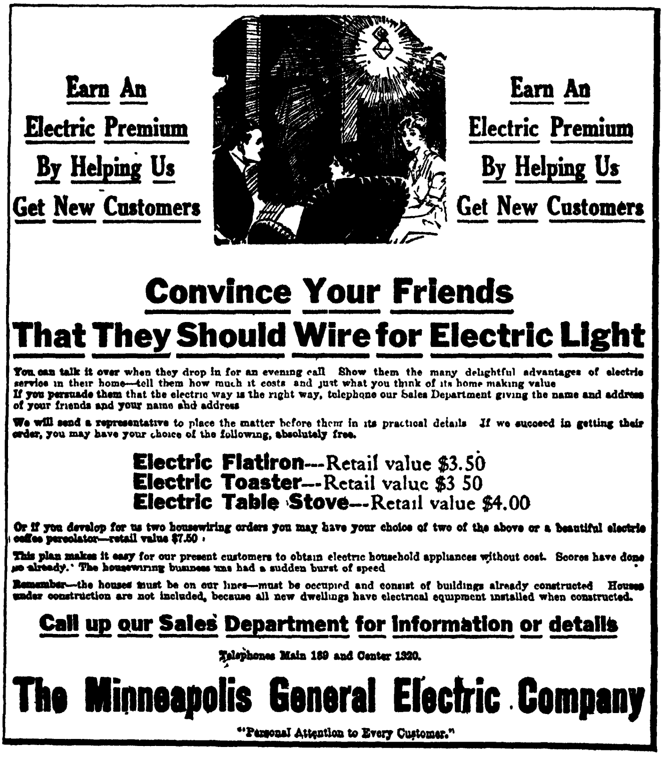
EXAMPLES OF CAMPAIGNS

58. Examples of Finished-building Wiring Campaigns. In paragraphs that follow some typical examples of successful campaigns are briefly outlined. It has been the endeavor to select those waged in cities and towns from the largest to the smallest, so that it will be reasonably certain that any reader will find some suggestions that apply to his own case. The electrical periodicals should be watched because they contain in almost every issue the records of or suggestions from some campaign which are often very valuable.

59. H. M. Byllesby Company Campaigns. This organization operates a number of central stations in different parts of the United States and has been very successful in increasing its business through wiring finished buildings. This company was one of the first in this country to appreciate that, though the small residence is of little importance individually to the central station, in the aggregate the small residences constitute a splendid load. The policy of the company has always been to co-operate with the contractors. The business was obtained largely through advertising and personal solicitation. An outline of some of the advertising methods are given in Par. **35** and in the following paragraphs.

One of the best proofs of the value of systematized solicitation of finished-building wiring contracts was found at Mobile, Ala. (population, 51,500, 1910 census), where in forty-five days 660 old buildings were wired and added to the company's list of electricity users. This is the more remarkable because of the fact that poor negroes who constitute about half the city's population formed a large quota of those who took advantage of the wiring proposition. See Par. **104,** Mobile, Ala.; Pars. **50** and **64,** Louisville; and the two following paragraphs.

59a. H. M. Byllesby & Company "Premium" Campaign in Minneapolis. The Minneapolis General Electric Company is the local company. The campaign almost doubled the normal volume of finished-buildings wiring business. Any customer of the company securing the order for wiring one house was awarded the choice of an: (1) electric sad iron, (2) electric toaster, (3) an electric table stove. For securing two house-wiring orders the customer was given an electric percolator.



Earn An Electric Premium By Helping Us Get New Customers

Earn An Electric Premium By Helping Us Get New Customers

Convince Your Friends That They Should Wire for Electric Light

You can talk it over when they drop in for an evening call Show them the many delightful advantages of electric service in their home—tell them how much it costs and just what you think of its home making value

If you persuade them that the electric way is the right way, telephone our Sales Department giving the name and address of your friends and your name and address

We will send a representative to place the matter before them in its practical details If we succeed in getting their order, you may have your choice of the following, absolutely free.

Electric Flatiron—Retail value $3.50
Electric Toaster—Retail value $3 50
Electric Table Stove—Retail value $4.00

Or if you develop for us two housewiring orders you may have your choice of two of the above or a beautiful electric coffee percolator—retail value $7.50

This plan makes it easy for our present customers to obtain electric household appliances without cost. Scores have done so already. The housewiring business has had a sudden burst of speed

Remember—the houses must be on our lines—must be occupied and consist of buildings already constructed Houses under construction are not included, because all new dwellings have electrical equipment installed when constructed.

Call up our Sales Department for information or details

Telephones Main 189 and Center 1320.

The Minneapolis General Electric Company

"Personal Attention to Every Customer."

FIG. 19*A*.—Newspaper advertisement explaining the "premium" offer of the Minneapolis General Electric Company.

While, under normal conditions in Minneapolis, from 75 to 100 finished-dwelling wiring contracts were secured each month, this class of business had a tendency to slump during the summer and fall. The premium campaign reversed this tendency. Premiums were given only in connection with contracts for finished buildings on existing lines of the company. The premium-seeking consumer rendered assistance in isolating and converting the prospective customer—usually a friend or acquaintance. An experienced salesman was sent when summoned by telephone to render aid. If the salesman closed the order, the consumer was given the premium.

During a campaign of less than four months 685 finished buildings were wired. This number included some apartment buildings, each of which (although each one contained from six to fifty new customers) was counted as only one building.

As to advertising: During the first month of the campaign the only publicity consisted in distribution of printed circulars that were mailed with the monthly bills. During the following three months, the premium plan was explained by forty-inch newspaper advertisements (Fig. 19*A*). One advertisement was printed each week in each of three daily papers. The response to the newspaper advertisements was gratifying. Most of the inquiries to the company were made via telephone. The advertisements were so written as to appeal to the housewives. A majority of the inquirers were women. The advertisements brought out the thought that customers of the company could easily convince prospectives because they knew from their own experience the value of the service.

A valuable feature of the campaign was that it promoted the use of electric household appliances. Every premium was placed in service by its receiver and thus became a revenue producer for the company. All wiring was installed by the regularly established contractors subject to their regular rates and terms of payment. No cut prices on fixtures or wiring were offered.

Only 300 electrical appliances were awarded for premiums for the 685 orders taken, which indicates that 90 per cent. of the increased business was influenced by the premium offer. A comparative statement of the finished-building wiring business in Minneapolis for the first nine months of 1913 and 1914 is given in the following table. Wiring installations in stores and commercial structures are not included.

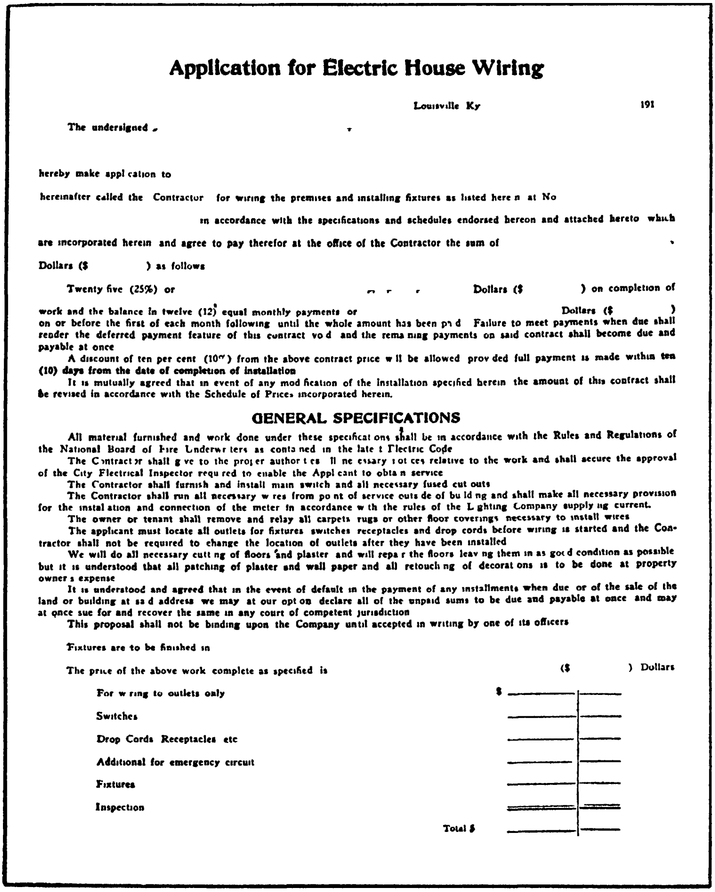
Period	Number of buildings wired		Percentage increase
	1913	1914	
January to June.	359	442	23
June.	104	153	47
July .	92	149	62
August..	82	150	83
September.	75	233	210

59b. The H. M. Byllesby Campaign at Louisville, Ky. The Louisville Gas & Electric Company is the local concern. The campaign started with a half page newspaper advertisement and this space was used as long as the campaign was aggressively continued. In a period of approximately ten months 1900 house-wiring orders were obtained. The campaign had the effect of stimulating the independent contractors who secured a large number of orders independently of the company. During a period of fourteen months the number of electric customers was increased 26 per cent. A certain proportion of this increase was due to normal business—new commercial customers, new residences and the like—but the greater proportion of this increase was due to the finished-building wiring campaign.

The contractors assumed all financial responsibility. As will be evident from a study of the contract, Fig. 19*B*, the company was not a party to the wiring agreement, but simply acted as an agent in closing the contracts for the customers. The contractors handled the installations on the time-payment plan, accepting an initial payment of 25 per cent. of the total amount upon the completion of the installation and the balance in six monthly payments. Where the whole amount was paid in cash, a discount of 10 per cent. was allowed.

The company confined its efforts to advertising and solicitation, giving the agreements that it secured to the contractors for execution. The agreement form was ultimately altered somewhat from that shown in Fig. 19*B*; on the revised form were given the names of a number of local contractors in good standing. The wiring jobs were apportioned among these concerns. The solicitation was restricted to finished residences on existing lines of the company. No business houses were wired on the terms indicated.

The advertising comprised a 30-inch display in each of the daily papers once each week. It has been estimated by the commercial department of the company that at least 75 per cent. of the house-wiring orders closed originated from newspaper advertisements.



Application for Electric House Wiring

Louisville Ky 191

The undersigned

hereby make application to

hereinafter called the Contractor for wiring the premises and installing fixtures as listed herein at No

in accordance with the specifications and schedules endorsed hereon and attached hereto which

are incorporated herein and agree to pay therefor at the office of the Contractor the sum of

Dollars ($) as follows

Twenty five (25%) or Dollars ($) on completion of work and the balance in twelve (12) equal monthly payments or Dollars ($) on or before the first of each month following until the whole amount has been paid Failure to meet payments when due shall render the deferred payment feature of this contract void and the remaining payments on said contract shall become due and payable at once

A discount of ten per cent (10%) from the above contract price will be allowed provided full payment is made within ten **(10) days from the date of completion of installation**

It is mutually agreed that in event of any modification of the installation specified herein the amount of this contract shall be revised in accordance with the Schedule of Prices incorporated herein.

GENERAL SPECIFICATIONS

All material furnished and work done under these specifications shall be in accordance with the Rules and Regulations of the National Board of Fire Underwriters as contained in the latest Electric Code

The Contractor shall give to the proper authorities all necessary notices relative to the work and shall secure the approval of the City Electrical Inspector required to enable the Applicant to obtain service

The Contractor shall furnish and install main switch and all necessary fused cut outs

The Contractor shall run all necessary wires from point of service outside of building and shall make all necessary provision for the installation and connection of the meter in accordance with the rules of the Lighting Company supplying current.

The owner or tenant shall remove and relay all carpets rugs or other floor coverings necessary to install wires

The applicant must locate all outlets for fixtures switches receptacles and drop cords before wiring is started and the Contractor shall not be required to change the location of outlets after they have been installed

We will do all necessary cutting of floors and plaster and will repair the floors leaving them in as good condition as possible but it is understood that all patching of plaster and wall paper and all retouching of decorations is to be done at property owner s expense

It is understood and agreed that in the event of default in the payment of any installments when due or of the sale of the land or building at said address we may at our option declare all of the unpaid sums to be due and payable at once and may at once sue for and recover the same in any court of competent jurisdiction

This proposal shall not be binding upon the Company until accepted in writing by one of its officers

Fixtures are to be finished in

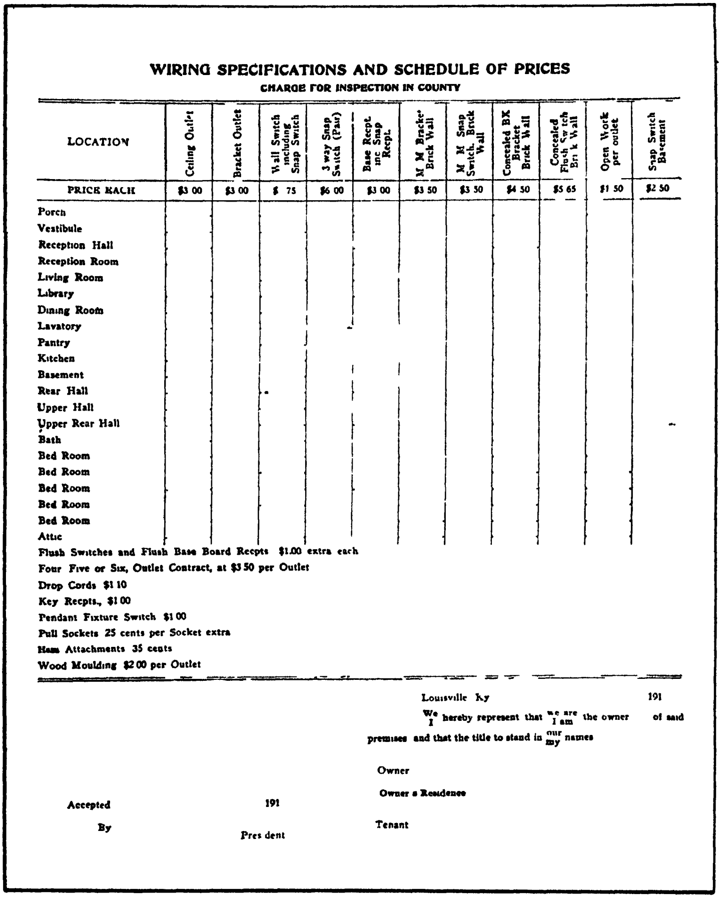
The price of the above work complete as specified is ($) Dollars

For wiring to outlets only	$	
Switches		
Drop Cords Receptacles etc		
Additional for emergency circuit		
Fixtures		
Inspection		
Total $		

FIG. 19*B*.—Face of application form used in the Louisville, Ky., Gas and Electric Company's Campaign.

Fig. 19*C* shows the unit price schedule adopted which was printed on the reverse side of the contract form. Pars. **50** and **64** give additional information relating to this campaign.

59c. Campaigns of the Union Electric Light & Power Company, St. Louis (population, 687,000; 1910 census). A campaign conducted from January 1, 1913, to Nov. 1, 1913, resulted in the connection of more than 5000 new residence patrons. A monthly minimum charge of 50 cents for residence service has been adopted. The company makes liberal use of newspaper advertising space.



WIRING SPECIFICATIONS AND SCHEDULE OF PRICES

CHARGE FOR INSPECTION IN COUNTY

LOCATION	Ceiling Outlet	Bracket Outlet	Wall Switch including Snap Switch	3 way Snap Switch (Pair)	Base Recpt. inc Snap Recpt.	M M Bracket Brick Wall	M M Snap Switch, Brick Wall	Concealed BX Bracket Brick Wall	Concealed Flush Switch Brick Wall	Open Work per outlet	Snap Switch Basement
PRICE EACH	$3 00	$3 00	$ 75	$6 00	$3 00	$3 50	$3 50	$4 50	$5 65	$1 50	$2 50
Porch											
Vestibule											
Reception Hall											
Reception Room											
Living Room											
Library											
Dining Room											
Lavatory											
Pantry											
Kitchen											
Basement											
Rear Hall											
Upper Hall											
Upper Rear Hall											
Bath											
Bed Room											
Bed Room											
Bed Room											
Bed Room											
Bed Room											
Attic											

Flush Switches and Flush Base Board Recpts $1.00 extra each
Four Five or Six, Outlet Contract, at $3 50 per Outlet
Drop Cords $1 10
Key Recpts., $1 00
Pendant Fixture Switch $1 00
Pull Sockets 25 cents per Socket extra
Ham Attachments 35 cents
Wood Moulding $2 00 per Outlet

Louisville Ky 191

We I hereby represent that we are I am the owner of said premises and that the title to stand in our my names

Owner

Owner s Residence

Accepted 191

By

President

Tenant

FIG. 19*C*.—Reverse side of form shown in Fig. 19*B*. This shows the price schedule adopted.

Typical advertisements are illustrated elsewhere. Circularizing and personal solicitation are also used extensively.

In a more recent campaign the price schedule shown in Par. **102** was used. The wiring is done by contractors but the company guarantees their work. In the contract covering the work the price of the first item carries the entire overhead cost. Should the prospective customer contend that he does not wish all of the outlets in the first item, he is informed that the cost will be $17.95 whether all of the outlets are installed or not. The result is that all of the outlets are installed and the use of appliances is thus stimulated.

Formerly the company in co-operating with the contractors in the city gave each a job in turn. The present policy is to give each contractor in turn $100 worth of business regardless of whether it is made up of one or several jobs. In this way the company hopes to distribute the work more equitably among the various contractors. In case a contractor receiving work from the new-business department of the company has no credit or responsibility, the central station requires him to furnish a bond in order that it shall not suffer loss should his work on its contracts fail to give satisfaction.

60. Campaign in Boston, Mass. (population, 670,600; 1910 census. A population of 1,000,000 is served by the company if the suburbs and towns supplied are included). Standardized price schedules (Par. **105**) were used which enabled any employee of th company to estimate the cost of wiring a house immediately upon inquiry without the assistance of a contractor or an experienced wireman. Every employee could tell specifically just what a partial or complete job would cost if he knew the number of rooms, the number of lighting outlets, switches and baseboard receptacles required.

The buildings were wired by accredited local contractors. Though the basic offer (Par. **105**) was for one outlet at $14.35, very few one-outlet contracts were made because of a well-directed effort on the part of the company toward securing a complete wiring contract. This was effected by leading the applicant along step by step and showing him by detailed prices how much more he could secure by a little larger payment. Care also was taken to point out that the cost of the work would be less if all the outlets were installed at the same time. Much co-operation was obtained from the contractors by means of a plan whereby the company pays the contractor $2 per customer plus 25 cents per outlet installed.

The installment plan adopted required an initial payment of $2.35, followed by monthly payments of $2 each for a period of six months—after the signing of the contract—covering the cost of one outlet for a total of $14.35. Customers were permitted to extend their payments to a maximum of twenty months; in case this monthly payment exceeded $5, greater extension of time was permitted than with smaller payments. The business that has been received in Boston through finished-building wiring campaigns amounted in twelve months to 1247 houses and $105,850 of wiring. The fixtures used in the Boston campaign are illustrated in Fig. 202. In one campaign in Boston 769 houses were wired in seven months. The average price, per house, for wiring was $83.50.

60a. Campaign of the Edison Electric Illuminating Company of Brooklyn, N. Y.[1] (see Par. **101a** for price schedule). A requirement of the proposition was that the kitchen was always included in any wiring installation. This room was selected as a basis for all prices because it was assumed that electricity would be used more in the kitchen than in any other room. One room having been wired, the price of wiring the balance is relatively low. Hence the small charge for additional rooms is an inducement for the consumer to equip his entire house.

As to terms: For wiring any combination of rooms, the company required an initial payment of not less than 8 per cent. of the total cost. Minimum monthly payment $2. Maximum period of monthly payments: $2 to $2.99, twelve months; $3 to $3.99, fifteen months; $4 to $4.99, eighteen months; $5.00 and above, twenty months. Payments were in no case allowed to extend over a period of twenty months.

The price schedule was based on averages of bids submitted by several reliable contractors. A majority of the local contractors were willing to do the work at the prices listed (Par. **101a**). A booklet containing a list of contractors and fixture dealers was furnished by the company to any person contemplating the installation of wiring. The work was apportioned as fairly as possible among the various contractors. Where in soliciting their own business, contractors encounter a person who does not care to pay cash down, he is referred to the easy payment plan described. Under this proposition, the contractor furnishes the material for wiring and installs the equipment while the central-station company supplies the fixtures.

---

[1] *Electrical World*, Oct. 31, 1914.

61. Campaigns in Pittsburgh, Pa. (population, 533,000; 1910 census). (J. E. McKirdy, in a paper "*The Wiring of Old Houses*" read before the Pennsylvania Electrical Association, 1912 convention.) The advertising methods used are outlined in Par. **36**. In 1911, 4000 free estimates were made and 1055 contracts, equivalent to 19,124 lamps of 16 c.p., were secured. In the first six months 357 houses were wired, equivalent to 6393 lamps of 16 c.p. In the last six months 698 houses were wired, equivalent to 12,733 lamps of 16 c.p., giving an average installation per house of eighteen 16-c.p. lamps.

In the first six months of 1912, free estimates numbering 985 were made, compared with 555 estimates made to the same day in 1911. From these were secured 569 contracts, equivalent to 9008 lamps of 16 c.p., giving an average per house of seventeen lamps. These figures include 266 stores. In the first six months of 1911, contracts numbering 106 were given to wiring contractors, whereas in the same period in 1912, 401 contracts were so placed.

It was realized by the company that it would be poor policy, both from an ethical and a business standpoint, to adopt any plan that would antagonize the local electrical contractors. Hence the company co-operated with the contractors wherever possible. Although many buildings were wired by the company's own wiremen, many jobs have been sublet to contractors. The contractors are paid by the company in thirty days, but the customer is permitted to pay in monthly installments extending over a period of a year. The company does all soliciting and estimating and assumes all expense in connection therewith, relieving the contractor of all costs except those involved in actually doing the work.

In general, the company wires only houses that contractors cannot wire with profit at the rates at which the company is doing wiring. Inasmuch as the company's men wire old buildings exclusively, they have become so expert at this work that they are able to make installations that would ordinarily be considered impossible of execution.

The inauguration of the campaign brought a protest from a committee of wiring contractors who contended that the central station was threatening the destruction of their business. It was explained to the contractors that a large number of houses had remained unwired, either through their lack of effort to wire them or their supposed excessive charges for wiring and that the illuminating company proposed to get this business on its lines. The contractors were informed that the illuminating company would give them any of the contracts they desired, besides assuming the expense of soliciting the business, making the estimates and securing the contracts.

Many of the contractors accepted this proposition and in 1911 they were given 473 contracts, amounting in excess of $20,000. The campaign stimulated the wiring contractors to greater efforts to secure business. The result was that many houses were wired by contractors of which the company knew nothing.

62. The group method of securing new business, employed by the Duquesne Light Company, and explained by H. H. Wood in his paper, *Wiring Old Houses*, read before the Pennsylvania Electrical Association Convention of 1912, provides a good example of the benefits a lighting company may reap from a finished-building wiring campaign. Thus, a group of twenty old houses, averaging six rooms each, in a suburb that had not previously been served with electricity, was wired. Gas mains did not reach the group and the residents used coal-oil lamps. The group was located possibly 1/4 mile from the company's pole lines. One resident made a request for an estimate for wiring his house. The estimator explained it would not be very profitable to run a pole line 1/4 mile long to serve one consumer, while if it were possible to secure several the lighting company would doubtless build a pole line to serve the group. On this basis the estimator secured twenty contracts.

63. A Kansas City campaign (population, 250,000; 1910 census). Contracts were executed by the company. The wiring was done by contractors. The schedule in Par. **108** shows the company's prices on time-payment contracts. A customer desiring to pay cash was given a lower bid. This schedule of prices was approved by the contractors and was so drawn as to allow them a fair profit. Later the list of prices was reduced 25 per cent. The average price of wiring a finished home in Kansas City was found to be $45.

The advertising methods comprised a liberal use of newspaper space and the circularization of a splendid list of about 10,000 prospects. It was assumed that any residence that could afford a telephone could afford electric light. The telephone directories were scrutinized and the addresses of all telephone subscribers that did not have electric lights were thereby obtained. The nucleus of a large mailing list was thus secured. It was found that personal solicitation was the most effective factor in obtaining business. Experience indicated that the best way for a solicitor to obtain the business was for him to systematically canvass his district several times. The second and third calls of the solicitors were more productive than the first.

63a. An Effective Double-socket Kitchen-or-Laundry Wiring Plan used in Kansas City. The Kansas City Electric Light Company offered to wire *any* residence kitchen or residence laundry for one double socket and furnish an electric iron and a lamp for $12. This amount was payable $1 down and $1 per month for eleven succeeding months. The wiring, socket, inspection, in fact everything was furnished on receipt of the initial payment of $1. The lamp for lighting could be fed from one of the sockets and the iron—or any other heating device—from the other socket. The plan has been extremely successful. Approximately half of the inquiries received in relation to the proposition developed into contracts for wiring the entire house. The company believes that in practically every instance where a double-socket installation has been made, the entire building will ultimately be wired.

The company financed prospective customers who could not afford to pay in one lump sum the entire cost of a wiring installation. The contracts secured by the lighting company's solicitors were awarded in rotation to three contractors, each contractor receiving every third job regardless of its size or character. At the completion of the installation they were paid in full by the lighting company. The new customer then had the privilege of paying the electric-service company for the wiring in twelve equal monthly payments. Although the company offered to finance customers for a period of twelve months, the majority of the accounts were settled in full within periods of from three to four months. When the system of financing customers' installations was adopted it was estimated that within thirty months the company would have $100,000 invested in wiring, but, owing to the desire of consumers to pay in full, the sum involved was only approximately $20,000. Some 2600 houses were wired within a thirty-month period.

64. A Campaign in Louisville, Ky. (population, 224,000; 1910 census). The city has about 40,000 dwellings. Of this number 15,000 are now connected to the Louisville Gas & Electric Company's lines. The average cost of the wiring and fixtures, complete with 40-watt lamps, has been $36.40 per house. For campaign purposes the city was divided into five districts. Each was covered by and in charge of a salesman who devoted all of his time to finished-building contracts. See also Pars. **50** and **59b,** for a more complete description of this campaign.

65. A two-month campaign for wiring finished buildings in Toledo, O. (population, 168,500; 1910 census) was inaugurated by the Railway and Light Company of that city in November of 1913. During the first few weeks an average of fifteen houses were wired each day. As the campaign progressed the results increased daily.

66. In Harrisburg, Pa. (population, 64,000; 1910 census), 550 finished houses were wired in 1913 due to the efforts of the central-station company. A number of these consumers were on a flat-rate basis with a current-limiting device but more than 25 per cent. of them applied for meter service.

66a. A Campaign at South Bend, Ind.[1] (population 53,700, 1910 census). See Par. **108a** for price schedule. The Indiana

[1] *Electrical World,* Oct. 3, 1914, page 672.

and Michigan Electric Company inaugurated this campaign to secure the possible business in portions of the city where the smaller residences are located. A controlled-flat-rate (Par. **57a**) method of charging was adopted. South Bend has many factories and a larger proportion of foreign population than a majority of American cities of the same size; about 33 per cent. of the population are foreign laborers. The average wage of these people probably does not exceed $1.50 to $1.75 a day. It is obvious that the cost of electric service and wiring for people of such incomes must be low.

The combination of the flat-rate method of charging and the low price wiring comprised an offer that could be considered by any home owner or renter. The flat rate for lighting is 1 cent a watt a month, based on 66 per cent. of the connected load. The minimum allowable connected load is 100 watts. The maximum connected load on a flat-rate contract was, for the time being, set at 400 watts. A Polish solicitor was retained to work among people of his own nationality and to assist the English speaking solicitors. A former campaign, which however did not involve the flat-rate method of charging, resulted in the wiring of about 1000 finished houses.

67. Campaign at Muncie, Indiana (population, 24,000; 1910 census). The Muncie Electric Light Company co-operated with six representative contractors. The contractors agreed upon the prices shown in the schedule of Par. **108.** It was also agreed that the company should receive 10 per cent. of the gross price for each contract that it handled on the installment plan. Upon the completion of a job and the city inspector's approval the contractor was paid in full by the lighting company. As shown in the schedule, the customer pays the company 20 per cent. of the amount of the bill in cash. The remainder is generally paid in ten equal monthly installments, but in special cases a longer time and smaller payments may be allowed.

The contracts, irrespective of their size, are assigned to the contractors in rotation. However, in order to keep the contractors' expenses at a minimum, the company may award a number of contracts in a certain part of town to some one contractor. He is thereby saved the expense of rehauling tools and material. Not more than ten contracts can be thus awarded in a group. When one contractor has received a group of contracts in one vicinity he is not awarded any additional contracts until the other co-operating concerns have received an equal number.

Contracts were accepted on the controlled-flat-rate basis, Par. **57a,** hence owners of even the smallest homes availed themselves of the company's offer. The ratio of population to consumers in Muncie is approximately six to one. In spite of this, forty-five contracts were secured during the first month that the plan was in operation. (*Electrical World*, July 11, 1914.)

68. A finished-building wiring campaign in Butler, Pa. (population, 20,700; 1910 census), conducted by the Butler Light, Heat and Motor Company. The standard proposition offered by the company covered the wiring of six rooms, complete with cord drops, 25-watt Tungsten lamps and shades for $21. No switches were included in the offer. During a two-month campaign the company with the assistance of the contractors wired 110 houses. Seventy-three of these were either partly or wholly equipped with room switches at additional cost to the owner.

69. A campaign at Marshalltown, Iowa (population, 13,500; 1910 census), conducted by the Iowa Railway and Light Company which owns the property, was quite successful. The results as given in *Electrical World* are shown in Table **14.** Contractors, co-operating, agreed upon a fixed price for the wiring installation that was featured. Advertising was confined exclusively to this "bargain" in wiring, the price being $22.50 for any four rooms, including wiring, two two-lamp fixtures, two drop cords and a lamp for each fixture. The company paid all advertising and soliciting charges. Boys were employed to distribute handbills and inquiry cards throughout the city. The prospect list was built from those of the cards that were returned. Although the contractors agreed to allow customers to pay for the wiring on the installment plan, the payments to extend over a period of five months, more than 50 per cent. of the business was settled on a cash basis or paid within thirty days. A total residence wattage of 34,285 was secured and ninety-one wiring contracts, aggregating $2,431.40, were given to the contractors.

70. The Citizens Gas & Electric Company of Mt. Vernon, Ill. (10,000 population), a Henry L. Doherty property, has been very successful in wiring finished buildings, particularly residences, using the price schedule given in Par. **109.** Contractors do the wiring. The company pays the contractors cash and, if desired, carries the account for one year for the customer, permitting him to pay on the installment plan. The company has been most successful in equipping the houses wired with drop cords and sockets instead of with fixtures. This is true particularly of the three- and four-room cottages of which there are many in Mt. Vernon. Later, if the consumer desires, he can purchase fixtures from the local contractors who follow him up in connection with this point. The existing unwired buildings are being wired at the rate of about 600 per year. Special newspaper advertisements were used with great effect.

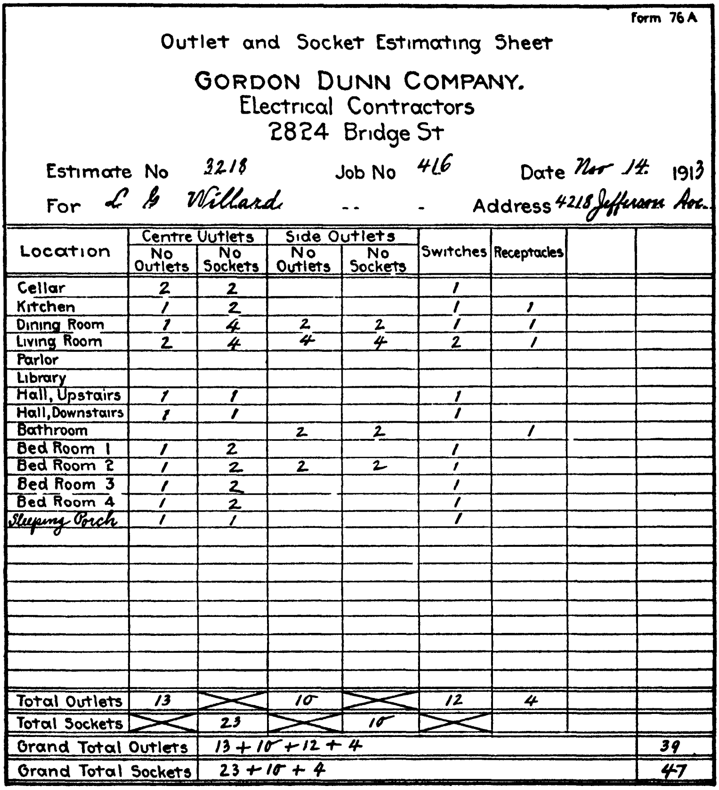
CHAPTER VI

COSTS AND PRICES

71. There are two methods of determining costs and prices for finished-building wiring. The first is by *detail estimating.* The other is by using *unit or "standardized" prices,* which are average values ascertained either through experience or by referring to actual cost figures of jobs that have been completed. Each of the methods will be discussed in following paragraphs.

72. Detail Estimates and Their Compilation. The estimator, who should be an experienced wireman, carefully surveys the premises and compiles a detail schedule of all the material required. Then the labor necessary is estimated, and the profit and overhead charge are added. The resulting estimate will appear something like that of **90.** It is obvious that in preparing many detail estimates there are items and groups of items that are used repeatedly. The estimator will make a list of such groups and their unit prices to save himself time and work and thus, even in preparation of detail estimates, standardized or unit prices are used to a large extent. Detail estimates have the advantage of accuracy but they require technical skill and considerable time for their preparation. It may require considerable time after the wireman has made his survey before he can submit his estimate. Meanwhile the prospect may have decided that he does not want wiring. The first man who calls on the prospect should be able to quote, and furthermore he should be a salesman rather than a wireman-estimator; hence the almost universal adoption of unit prices. The unit prices should be such that the salesman with little technical knowledge can use them effectively.

73. A convenient form for rough estimating is shown in Fig. 20. By rough estimating is meant figuring on a basis of so much per outlet without endeavoring to make a detailed summary of labor and material. The form is as convenient for new as for finished building work. The number of outlets and the number of sockets required for each room is tabulated as illustrated. The number of sockets and outlets required and their location can be ascertained either from the architect's plans or from an inspection of the building. After tabulation, the totals are struck and it is then easy to determine the cost of the job by multiplying the unit cost per outlet by the number of outlets and making the necessary additions for switches, receptacles and the other fittings required. In the form shown, the switch outlets are treated, from the standpoint of cost, the same as center and side outlets. In



Form 76 A

Outlet and Socket Estimating Sheet

GORDON DUNN COMPANY.
Electrical Contractors
2824 Bridge St

Estimate No 3218 Job No 416 Date Nov 14. 1913

For L G Willard -- - Address 4218 Jefferson Ave.

Location	Centre Uutlets		Side Outlets		Switches	Receptacles		
	No Outlets	No Sockets	No Outlets	No Sockets				
Cellar	2	2			1			
Kitchen	1	2			1	1		
Dining Room	1	4	2	2	1	1		
Living Room	2	4	4	4	2	1		
Parlor								
Library								
Hall, Upstairs	1	1			1			
Hall, Downstairs	1	1			1			
Bathroom			2	2		1		
Bed Room 1	1	2			1			
Bed Room 2	1	2	2	2	1			
Bed Room 3	1	2			1			
Bed Room 4	1	2			1			
Sleeping Porch	1	1			1			
Total Outlets	13		10		12	4		
Total Sockets		23		10				
Grand Total Outlets	13 + 10 + 12 + 4							39
Grand Total Sockets	23 + 10 + 4							47

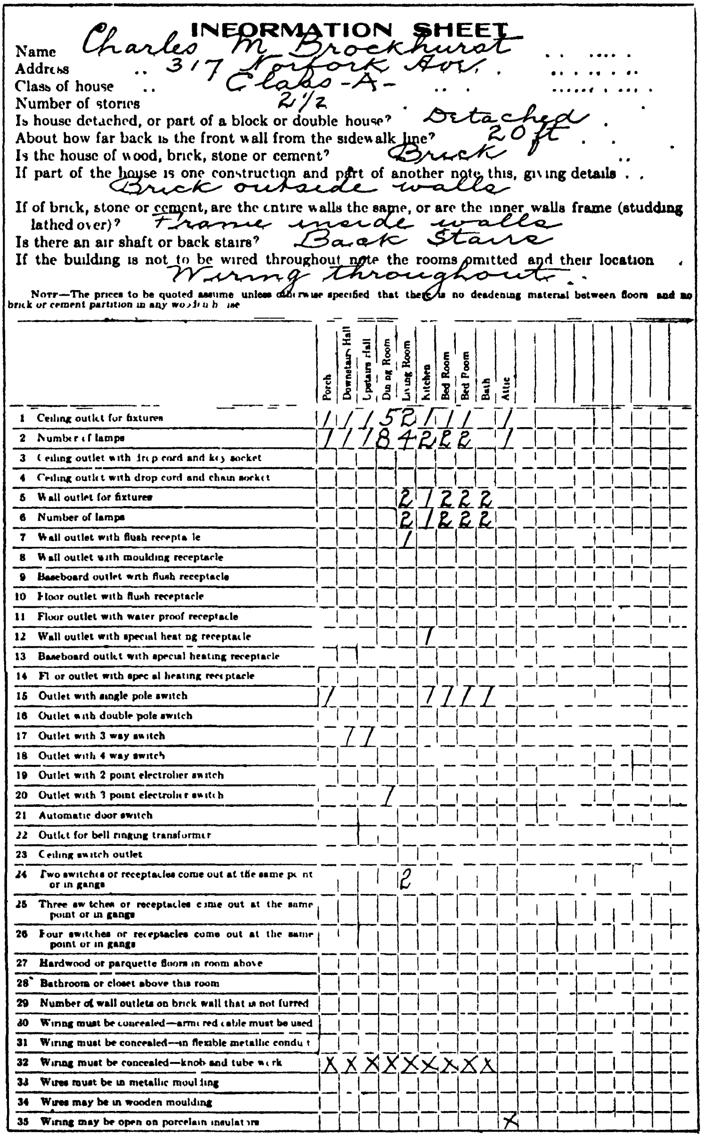
FIG. 20.—Convenient estimating form.

some localities it is the practice to use a different unit price for switch outlets than for the others. In such cases the form can be altered accordingly.

The number of sockets being known, the number of branch circuits required can be determined by applying the *Code* rule (23-*d*) which specifies that not more than sixteen sockets, or no lamp load exceeding 660 watts, shall be served by one cut out. It is not customary to connect more than twelve sockets to one branch circuit.

74. A preliminary information sheet on which may be listed all of the data that the prospective consumer can give is shown in Fig. 21. It is the form suggested in the 1913 *Report of the Committee on Wiring Existing Buildings* of the National Electric Light Association. The form is merely a suggestion and is probably too elaborate for ordinary conditions. It is intended to list all of the questions that the customer only can answer. It can be abridged to suit local conditions. It is not the intention to list on this sheet the questions that must be answered by the central station or the contractor.

75. Standardized or unit prices are used almost exclusively in finished-building wiring campaigns for the reasons suggested in preceding paragraphs. They afford a quick, fairly accurate means of giving the prospect a price. They should be (this classification and much of the other information that follows was suggested by an *Electrical World* article by H. L. Parker, "*Standardized Interior Wiring Prices*"): (1) SIMPLE, so that a salesman with little technical knowledge can handle them successfully; (2) FLEXIBLE, so as to be accurate for divergent conditions and so as not to depend too much on the law of averages; (3) EQUITABLE, so that the prices will be consistent and be in proportion, as nearly as possible, to the actual cost of each installation, and (4) FAIR, so that the central station or the contractor can realize a reasonable profit. The methods of determining unit wiring prices may be divided into four different classes: (1) FLAT PRICE PER INSTALLATION, (2) UNIT PRICE PER LAMP OR SOCKET, (3) PRICE PER OUTLET and (4) PRICE PER OUTLET VARYING WITH NUMBER OF LAMPS. Each of these classifications is discussed in the following paragraphs.



INFORMATION SHEET

Name Charles M Brockhurst

Address 317 Norfork Av.

Class of house Class-A-

Number of stories 2½

Is house detached, or part of a block or double house? Detached

About how far back is the front wall from the sidewalk line? 20 ft

Is the house of wood, brick, stone or cement? Brick

If part of the house is one construction and part of another note this, giving details. Brick outside walls

If of brick, stone or cement, are the entire walls the same, or are the inner walls frame (studding lathed over)? Frame inside walls

Is there an air shaft or back stairs? Back Stairs

If the building is not to be wired throughout note the rooms omitted and their location. Wiring throughout.

NOTE—The prices to be quoted assume unless otherwise specified that there is no deadening material between floors and no brick or cement partition in any wooden house.

		Porch	Downstairs Hall	Upstairs Hall	Dining Room	Living Room	Kitchen	Bed Room	Bed Room	Bath	Attic
1	Ceiling outlet for fixtures	1	1	1	5	2	1	1	1		1
2	Number of lamps	1	1	1	8	4	2	2	2		1
3	Ceiling outlet with drop cord and key socket										
4	Ceiling outlet with drop cord and chain socket										
5	Wall outlet for fixtures					2	1	2	2	2	
6	Number of lamps					2	1	2	2	2	
7	Wall outlet with flush receptacle					1					
8	Wall outlet with moulding receptacle										
9	Baseboard outlet with flush receptacle										
10	Floor outlet with flush receptacle										
11	Floor outlet with water proof receptacle										
12	Wall outlet with special heating receptacle						1				
13	Baseboard outlet with special heating receptacle										
14	Floor outlet with special heating receptacle										
15	Outlet with single pole switch	1					1	1	1	1	
16	Outlet with double pole switch										
17	Outlet with 3 way switch		1	1							
18	Outlet with 4 way switch										
19	Outlet with 2 point electrolier switch										
20	Outlet with 3 point electrolier switch				1						
21	Automatic door switch										
22	Outlet for bell ringing transformer										
23	Ceiling switch outlet										
24	Two switches or receptacles come out at the same point or in gangs					2					
25	Three switches or receptacles come out at the same point or in gangs										
26	Four switches or receptacles come out at the same point or in gangs										
27	Hardwood or parquette floors in room above										
28	Bathroom or closet above this room										
29	Number of wall outlets on brick wall that is not furred										
30	Wiring must be concealed—armored cable must be used										
31	Wiring must be concealed—in flexible metallic conduit										
32	Wiring must be concealed—knob and tube work	X	X	X	X	X	X	X	X	X	
33	Wires must be in metallic moulding										
34	Wires may be in wooden moulding										
35	Wiring may be open on porcelain insulators										X

FIG. 21.—Information sheet.

76. The flat-price-per-installation standardized price is properly used only for short aggressive campaigns. For example: The central station or contractor offers to wire a house of a given number of rooms, for a certain number of lamps, for a stipulated amount. Where there are many houses of about the size and construction to which the offer applies in the community and it is contemplated to wire a considerable number of them, the method can be made a splendid load builder. Some of the installations will cost much more than others but the average cost plus profit per job should be about equal to the advertised price per job, if the advertised price was judiciously selected. In other cases the central station will agree to wire a house and also furnish the fixtures all for a given flat amount. An example of such a proposition is given in the Mobile Electric Company schedule in Par. **104.** The advantage of the flat-rate-per-job method is that its proposition is very simple and is readily understood by the prospective customer. It is therefore capable of being advertised effectively. Its disadvantage is its inflexibility.

77. The Unit Price Per Lamp or Socket. With this method the number of outlets necessary is not considered. The method cannot be accurate or equitable because a consumer who had wiring done for fourteen lamps from fourteen outlets would pay the same price as one that had wiring installed for fourteen lamps from four outlets. Simplicity is a point greatly in favor of the method. It is readily understood by any one that can read and has given excellent results in certain cases.

78. Unit Price per Outlet. This is the method that, with various modifications, is more widely used than any other for the determination of prices for finished-building wiring. It is sufficiently simple that the solicitor salesman can grasp it readily. It is quite accurate. On the whole it is giving satisfaction. The important variations of the method are:

(1) FLAT PRICE PER OUTLET INCLUDING BOTH LAMP AND SWITCH OUTLETS. The advantage is simplicity. It is fairly accurate for small houses unless three-way and electrolier switches are specified. Where such switches are specified and for large houses it is apt to give prices that are too low—that is, if the same

prices are fair for small houses with ordinary switches. Switches themselves are not included in the prices.

(2) A Flat Price for Outlets Only, Price Additions Being Made for Switch Outlets and Switches. This method has been utilized, but usually with the addition that a price increment is also made for the cost of the entrance to the building as discussed in the following item.

(3) A Flat Price for Service Entrance, Including Main Switch and Cut Out, Loop for Meter, Etc., to Which is Added a Price per Lamp Outlet or Switch Outlet. The National Electric Light Association cost and price data given in following paragraphs were determined on this basis, which is quite equitable and accurate inasmuch as the cost of any interior wiring installation divides itself very naturally into three items: (*a*) *Service Entrance*, (*b*) *Lamp Outlets* and (*c*) *Switch Outlets*. It is obvious, however, that the price of any job, where there is more than one branch circuit or twelve lamps, will be determined not only by the number of outlets but also by the number of lamps. This is because that for each additional twelve (or less) lamps there should be one additional branch circuit with its cut out and its run from the distribution center. The following method takes this feature into consideration.

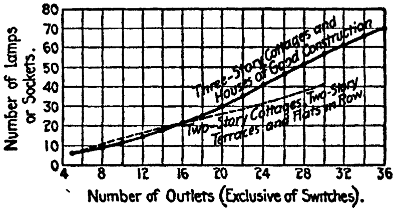


Fig. 22.—Relation between number of lamps and number of outlets.

78a. Price per Outlet Varying with the Number of Lamps. This method was proposed by H. L. Parker of the Consolidated Gas, Electric Light & Power Company of Baltimore and described in his article "Standardized Interior Wiring Prices" in *Electrical World* for Mar. 9, 1912. The method is used by the Baltimore Company. A table illustrating its application is given in **96**. The relation obtaining between the number of outlets and the number of sockets in residences as ascertained by surveys made in Baltimore is shown in Fig. 22. These relations were used in compiling the table, it being assumed that each lamp or socket consumes 50 watts and that there are twelve or thirteen lamps on each branch circuit.

79. Classification of Buildings for Estimating on a Unit or "Standardized" Basis. It is usually desirable if not necessary to divide into classes the buildings, of different types of construction, that may be wired. In small cities where nearly all buildings are of one type of construction—frame exterior and interior construction—such a classification is not necessary. In cities where several distinct types of construction are encountered, classification has been found necessary. Frequently the classification may be based on the normal rental value of the building. The price schedules given in **98** to **101** illustrate one method of classification.

80. The relation between number of outlets and number of sockets in residences as determined by H. L. Parker is shown graphically in Fig. 22. Surveys were made of a large number of residences in Baltimore each having the same number of outlets, excluding switch outlets, and results were plotted into the curves shown. For example, twenty houses each having eighteen outlets had an average of twenty-five sockets connected.

81. Cost data given in the 1913 National Electric Light Association report of the Committee on Wiring of Existing Buildings are given in paragraphs that follow. In every instance such data are designated by the initials *N.E.L.A.* In compiling these data the committee secured information from a number of representative central stations and, after correcting for obvious errors, struck a mean between the different figures submitted. The values given therefore are average values and obviously will not apply in all sections of the country. Unless otherwise specified, the costs do not include extra fittings such as switches, receptacles, fixtures and the like. They cover simply the wiring.

82. Labor Costs. The reporters were requested to adjust all labor costs to rates of $4 and $2 a day respectively, for wiremen and helpers, hence it can be assumed that the labor in all of the tables of costs given in following paragraphs and designated "*N.E.L.A.*" are charged on this basis, which is fairly representative for the whole country.

83. Overhead and General Expense Charges on Interior Wiring. Data gathered by the National Electrical Contractors Association from members widely distributed throughout the country, and doing annual gross businesses of from $10,000 to $100,000 a year, indicate that the average expense of conducting a contracting business is 22.2 per cent. In other words, 28.6 per cent. should be added to the net cost of all labor and material to secure the actual average cost of a job. In round numbers 30 per cent. should be added to the sum of labor and material costs to obtain the actual cost. The profit should be added to value thus obtained. It is a decided error for a contractor or central station to disregard these overhead charges. A central station may bury them in its bookkeeping but they are there nevertheless. On the above basis, general expense or overhead is assumed to include such items as salaries, rents, light, heat, power, telephone, telegraph, office help, insurance, advertising, overseeing, freight, cartage and expressage, printing and postage. The values given in the *N.E.L.A.* cost data in following tables cover cost of labor and material plus 30 per cent. for general expense.

84. Profits on and List Prices for Finished-building Wiring Jobs. Whether a central station that is wiring buildings should or should not include a profit in its prices to consumers is a question that must be determined by local conditions. The general opinion appears to be that, as a general proposition, a profit should be charged in order to protect the contractors. Electrical contractors ordinarily expect a profit of something between 10 and 25 per cent. In the *N.E.L.A.* cost tables in following paragraphs the costs have been doubled to obtain the list prices given. Discounts based on the conditions obtaining in any particular community can be applied to these list prices.

85. Labor cost for installing switches (*N.E.L.A.*; see Pars. **81** to **84**), that is, for mounting and connecting them after the wiring is installed, ranges from 15 to 40 cents per switch. A fair average cost is 25 cents per switch.

86. Effect of Municipal Wiring Rules on Cost of Wiring. Usually the requirements that municipalities sometimes impose, additional to those of *The National Electric Code*, increase the cost of wiring. For instance in Chicago, Denver and certain other places, all concealed work must be in conduit, which renders it very expensive. In Pittsburgh, the municipal rules require that double-pole switches be used for all circuits to combination gas-electric fixtures. This has the effect of increasing the price per room where there are combination fixtures to $5 or $6 (for concealed knob and tube work). With pull-chain or key sockets, provided their use was permitted, the price could be decreased to $3 or $3.50 per room. Obviously, additional wiring restrictions tend to retard the wiring of finished buildings because of the accompanying feature of additional cost.

87. Cost of Cutting Hardwood and Parquetry Floors. (See Pars. **81** to **84.**) Cost values from different parts of the country range from 50 cents to $3 per outlet. Where the wireman is not competent to do the cutting and a skilled carpenter must be employed the cost is high. Where wiremen are trained to do it a low cost results. Certain contractors pay men that are experts at hardwood floor work 25 cents a day more than ordinary wiremen receive and under these conditions the resulting increased cost per outlet under hardwood floors is small. Ordinarily, contractors do not handle enough hardwood floor work to justify this procedure. Probably the average outlet under hardwood costs $2.50 without and $3.25 with overhead, more than an outlet under a soft-wood floor (*N. E. L. A.*).

88. The discrepancies between the prices quoted in different parts of the country for old-building wiring are due to causes which are readily explained if they are understood. There may be a slight difference in the cost of material and a material difference in the cost of labor in different sections. The greatest difference is due, probably, to the policy that the central station assumes in regard to the contractor. If conditions are such, in the community where the wiring is being done, that a generous profit can be allowed the contractor without decreasing materially the amount of business obtained, the central station usually co-operates with the contractors and uses their price schedules. However, if it is imperative that the wiring be installed at absolute minimum prices, the central station frequently does the work itself and bills the consumer with the cost of the job, that is, cost of labor and material plus an overhead charge but without any profit. Another cause of variations in prices is that due to differences in overhead costs. The overhead costs of the small-town contractor amount to practically nothing. If he makes good day wages he is, frequently, satisfied. In cities where rents and other expenses are high, overhead charges are considerable items. Fig. 23 shows graphically some of these discrepancies. The graph was plotted by H. L. Parker. This graph was plotted

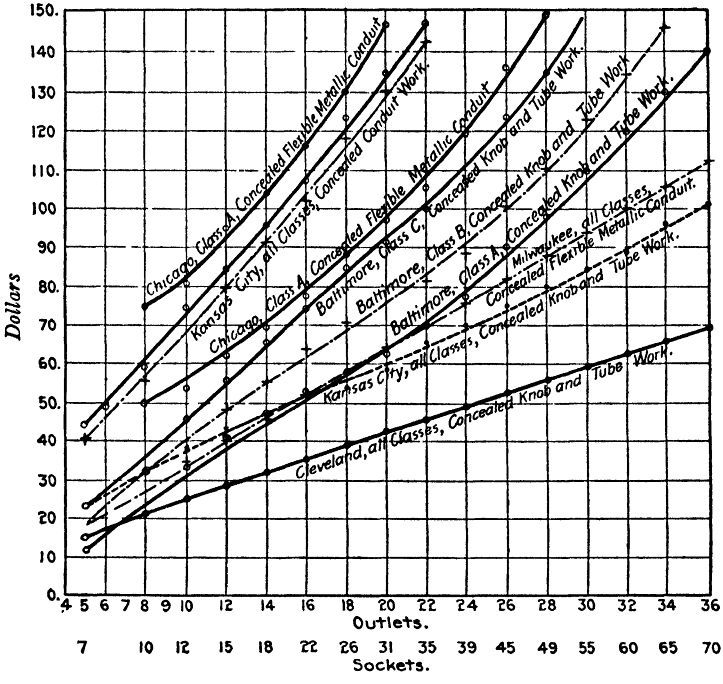


FIG. 23.—Graph showing differences in wiring prices in different communities.

several years ago and may not represent prices now in force. Experience has shown that, where wiring prices are standardized by the central station and the schedules distributed widely, the contractors usually follow the lead of the central station and a fairly uniform scale of prices throughout the community results.

89. Average Prices for Wiring Finished Frame Buildings. In the average town, up to possibly 12,000 or 15,000 inhabitants, where there are no unions and where contractors' establishments are small, involving light overhead charges, the contractors will frequently make a flat rate to the consumer of something between $1.25 to $3.25 per outlet for "roughing in" with concealed knob and tube work in rooms which do not have hardwood floors above. Probably a fair average price is $2 per outlet. This figure ordinarily provides a fair margin of profit for the contractor. Switches, fixtures and lamps are not included.

90. An example of an itemized estimate, as contrasted with an estimate based on unit prices per outlet and for switches and the like, is given in the following table. The figures are those of the Consolidated Gas, Electric & Power Company operating in Baltimore, Md. Class of work: concealed knob and tube. Service-entrance in cellar. Meter loop and cut outs in cellar. Wood molding in basement and attic.

Room	Wiring Details, Etc.	Price
Service entry	20 ft ¾-in. conduit	$0.740
	6 ¾-in. pipe bands	0 012
	12 1¼-in. No. 10 F. H. bright screws	0 012
	¼ lb. 10D. nails	0 005
	1 A. 4122 pipe taplet	0 146
	1 No. 5267 pipe taplet hood	0.153
	1 No. 4125 pipe taplet	0 284
	1 No. 602 pipe taplet cover.	0.041
	1 ¾-in. conduit coupling	0 050
	2 ¾-in. conduit ells	0 200
	1 ¾-in. gas ell	0 020
	1 ¾-in. × 3-in. close nipple	0.022
	3 ¾-in. locknuts	0 012
	3 ¾-in. bushings	0.033
	50-ft. No. 10 D. B. R. C. Wire	0.700
	1 No. 35367 G. E. cut-out switch.	0.225
	2 25-amp. fuse plugs	0 040
	2 20-amp. fuse plugs	0 040
	1 9 × 10 in. meter board	0 063
	1 16 × 24-in. meter board	0 400
	6 1½-in. No. 10 R. H. blued screws	0 006
Grounding service	15-ft. single-groove molding and capping	0.180
	17-ft. No. 6 S. B. R. C. wire.	0.459
	2 A all in one ground clamps	0.120
Pantry	1 No. 500 loom box	0.038
	1 ⅜-in. stud	0 017

Room	Wiring Details, Etc.	Price
Kitchen	1 500 loom box	0 038
	1 ⅜ in stud	0 017
Basement	1 No 100136 P & S receptacle	0 153
	1 No 88985 G E switch	0 136
	30 ft 1½ in 2-wire molding and capping	0 330
Dining room	1 No 500 loom box	0 038
	1 ⅜-in stud	0 017
	1 CC 2½ in 2-gang switch box	0 180
	1 No 2081 H & H flush switch	0 168
	1 No 4077 H & H flush switch plate B B	0 053
Hall	1 No 500 loom box	0 038
	1 ⅜-in stud	0 017
	1 CC 2½ in 2-gang switch box	0 180
	2 No 2083 H & H flush switches	0 520
	1 No 4078 H & H flush switch plate B B	0 105
Parlor	1 No 500 loom box	0 038
	1 ⅜ in stud	0 017
	1 No 2081 H & H flush switch	0 168
	1 No 4077 H & H flush switch plate B B	0 053
	1 CC 2½ in single-gang switch box	0 085
Porch	1 No 500 loom box	$0 038
	1 ⅜ in stud	0 017
	1 No 2081 H & H flush switch	0 168
	1 No 4077 H & H flush switch plate B B	0 053
	1 CC 2½ in single-gang switch box	0 085
Hall, second story	1 No 500 loom box	0 038
	1 ⅜ in stud	0 017
	2 No 2083 H & H flush switches	0 520
	1 No 4078 H & H flush switch B B plate	0 105
	1 CC 2½ in 2-gang switch box	0 180
Front bed room	1 No 500 loom box	0 038
	1 ⅜ in stud	0 017
	1 No 2081 H & H flush switch	0 168
	1 CC 2½ in single-gang switch box	0 085
	1 No 4077 H & H flush switch plate B B	0 053
Middle bed room	1 No 500 loom box	0 038
	1 ⅜ in stud	0 017
Bath room	1 No 500 loom box	0 038
	1 ⅜-in stud	0 017
	1 No 2081 H. & H flush switch	0 168
	1 No 4077 H & H flush switch plate B B	0 053
	1 CC 2½-in single gang switch box	0 085
Rear room	1 No 500 loom box	0 038
	1 ⅜-in stud	0 017

Room	Wiring Details, Etc.	Price
Attic	1 No. 50726 Paiste receptacle	0.115
	1 No. 88985 G. E. switch	0.136
Miscellaneous	1000-ft. No. 14 S. B. R. C. wire	7.000
	150 $\frac{5}{16}$-in. × 4-in. tubes	0 600
	50 $\frac{5}{16}$-in. × 6-in. tubes	0 300
	50 No. 5½-in. split knobs	0.350
	250-ft. ¼-in. circular loom	3.250
	70-ft. 1½-in.-2 wire molding & capping	0.770
	50 No. 1 loom bushings	0.700
	3 No. 4090 Paiste molding taplets.	0.366
	1 No. 4099 Paiste molding taplets.	0.101
	12 1-in. No. 8 R. H. blued screws	0.012
	50 2½-in. No. 8 F. H. bright screws	0.100
	50 ¾-in. No. 5 F. H. bright screws	0.050
	8 1½-in. No. 8 R. H. blued screws	0.0064
	2 No. 61935 G. E. cut-outs	0.180
	4 10 amp. fuse plugs	0.080
	12 No. 6102 pipe clamps	0.300
Total material		$22.84
Labor, electrician, three and one-half days @ $3.50.		12.25
Helper, three and one-half days @ $2.00.		7.50
Carfare, two men		0 60
Auto-truck charges		1 50
		$44.19
Plus 33⅓ per cent. (for overhead).		14.73
Total price to customer		$58.92

91. Costs and List Prices of Services, Entrances and Runs to Centers of Distribution. See Pars. **81** to **84**. Entrance has a capacity of from 1 to 100 lamps. The cost values assume that

Item	Cost	List
1 Each pole and stretch of wire (special prices if blasting is required)	$25.00	$50.00
2 Each foot of underground service (special prices if in macadam or paving)	1.10	2.20
3 For service pipe up to 20 ft.	6.00	12.00
4 Each additional foot	0.30	0.60
5 Ground wire	4.00	8.00
6 Service switch	2.25	4.50
7 Basement run	11.50	23.00
8 Meter board	0.50	1.00

the service pipe extending from the outside of the building into the basement is of 3/4-in. diameter wrought iron conduit, and that it is 20 ft. long and contains 50 ft. of No. 8 rubber-insulated, double-braid, solid wire; bolts and clips and two condulets are included. Ground wire is assumed to be 15 ft. of No. 4. Run to distribution center is assumed to be 40 ft. of armored cable or of rubber-covered wire in rigid conduit.

Or all items, 3 to 8, inclusive, are covered by the following figures:

Service entrance, etc.	$15.00	$30.00
For each extra outlet, add.	0.30	0.60

92. Cost of Standard Ceiling Outlets Wired in Accordance with Various Methods. (*N.E.L.A.*) See Pars. **81** to **84**. The cost of a ceiling outlet is assumed to comprise: (1) Its proportion of distribution box, cut out and fuse; (2) the loop to the outlet; and (3) the outlet box in concealed work or the rosette in open work. Obviously, the cost is essentially the same for a ceiling lamp outlet as for a ceiling switch outlet. The values contemplate soft-wood floor construction. Costs for hardwood floors are given elsewhere.

No.	Method of wiring	Costs			
		Labor	Material	Total[1]	Relative
1	Flexible metallic conduit.	$2.00	$2.00	$5.20	100
2	Armored cable.	1.75	2.00	4.87	94
3	Metallic molding.	1.50	1.75	4.23	81
4	Concealed knob and tube work, some loom.	1.50	1.50	3.90	75
5	Wooden molding.	0.75	0.85	2.60	50
6	Open wiring	0.60	0.75	1.75	34

[1] This includes 30 per cent. for general expense.

93. Costs and List Prices of Outlets of Various Types. These are *N.E.L.A.* data. See Pars. **81** to **84**. The list prices are 200 per cent. of the cost in each case to permit the quoting of discounts for given sets of conditions.

No.	Method of wiring	Standard outlets[1]		Outlets for double-pole switches, two-point electrolier switches or automatic door switches. *These are 130 per cent. of Standard Outlet values*		Ceiling switch or pilot lamp at location chosen by contractor. *These are 30 per cent. of Standard Outlet values*	
		Cost	List	Cost	List	Cost	List
1	Concealed armored cable.	$4.87	$9.74	$6.33	$12.66	$1.46	$2.92
2	Concealed flexible metallic	5.20	10.40	6.76	13.52	1.56	3.12
3	Concealed, ordinary.....	3.90	7.80	5.07	10.14	1.17	2.34
4	Metallic molding........	4.23	8.46	5.50	11.00	1.27	2.54
5	Wooden molding	2.60	5.20	3.38	6.76	0.78	1.56
6	Open wiring............	1.75	3.50	2.28	4.50	0.525	1.05

[1] Standard outlets include ceiling, wall, baseboard and floor outlets for current, single-pole switches and bell-ringing transformers.

No.	Method of wiring	Pair of three-way switches. *These are 320 per cent. of Standard Outlet values*		Four-way[2] switches or three-point electrolier switches. *These are 160 per cent. of Standard Outlet values*		Heating outlets. *These are 200 per cent. of Standard Outlet values*	
		Cost	List	Cost	List	Cost	List
1	Concealed armored cable.	$15.58	$31.16	$7.79	$15.58	$9.74	$19.48
2	Concealed flexible metallic	16.64	33.28	8.32	16.64	10.40	20.80
3	Concealed, ordinary.....	12.48	24.96	6.24	12.48	7.80	15.60
4	Metallic molding... ...	13.54	27.08	6.72	13.44	8.46	16.92
5	Wooden molding...	8.32	16.64	4.16	8.32	5.20	10.40
6	Open wiring.......... .	5.60	11.20	2.80	5.60	3.50	7.00

[2] Four-ways used only in connection with a pair of three-way switches.

94. Costs and List Prices of Extras. These are *N.E.L.A.* data. See Pars. **81** to **84** inclusive; also see tables of costs and prices of outlets.

Item	Cost	List
For each outlet that involves cutting or dodging hardwood, add	$3 .25	$6 .50
For each outlet on brick wall, not furred (concealed jobs)	3 .20	6 .40
For each gang switch, credit for second and subsequent outlets	0 .65	1 .30
Door outlet from bell-ringing transformer	2 .00	4 .00
Emergency system, one circuit, armored cable.	40 .00	80 .00
Installing switches, receptacles, etc., each.	0 .25	0 .50
Installing automatic door switch.	1 .00	2 .00
Installing bell-ringing transformer	1 .00	2 .00

For fittings themselves use market price plus general expense and profit.

95. Baltimore, Consolidated Gas, Electric Light and Power Company Lamp-outlet, Unit-price Schedule. The following charges are for installing knob-and-tube wiring for lamp outlets, in any finished building the inner walls of which are of wooden lath and plaster on wooden studding. Where outlets, on stone and brick walls, must be made, the additions given in the list below the table apply. Values in the table indicate the price to the consumer, in dollars, for a certain number of outlets feeding a certain number of sockets. Switches and switch wiring and miscellaneous fittings are not included in the values given in the following schedule.

Additions specified in Table **96** must be made therefor. A charge of 25 per cent. for overhead has been included in these prices. The price of the service entrance has been included in the tabulated values.

OUTLETS IN STONE OR BRICK. Where it is found necessary to make an outlet on a wall or partition of either of these materials, that is, where the surface must be channelled and conduit used, a charge of $3 per outlet in addition to the charges listed above, is made for each such outlet.

METAL MOLDING OUTLETS. An additional charge of $2 is made for each metal molding outlet.

OUTLETS UNDER HARDWOOD FLOORS. For ceiling or wall outlets under hardwood floors there is an additional charge of $2 per outlet.

GROUNDING SERVICES. All services must be grounded to a water pipe or ground plate for which there is an additional charge of $3.

Number of outlets	Number of sockets or 50–watt lamps					
	4 to 12	13 to 24	25 to 36	37 to 48	49 to 60	61 to 72
1 to 4	18 00	20.00				
5	22.50	24.50				
6	25.50	27.50				
7	28.00	30.00	32.00			
8	30.80	32.00	34.00			
9	34.65	35.75	37.75			
10	38 50	39.50	41.50	45.50		
11	42.35	43.25	45.25	49.25		
12	46.20	47.00	49.00	53.00		
13		50.75	52.75	56.75	58.75	
14		54.50	56.50	60.50	62.50	
15		58.25	60.25	64.25	66.25	
16		62.00	64.00	68.00	70.00	72.00
17		65.75	67.75	71.75	73.75	75.75
18		69.50	71.50	75.50	77.50	79.50
19		73.25	75.25	79.25	81.25	83.25
20		77.00	79.00	83.00	85.00	87.00
21		80.75	82.75	86 75	88.75	90.75
22		84.50	86.50	90 50	92 50	94.50
23		88.25	90.25	94.25	96.25	98.25
24		92.00	94.00	98.00	100.00	102.00
25			95.25	99.25	101.25	103.25
26			98.90	102.90	104.90	106.90
27			102.55	106.55	108.55	110.55
28			106.20	110 20	112.20	114.20
29			109.85	113.85	115.85	117.85
30			113.50	117.50	119.50	121.50
31			117.15	121 15	123.15	125.15
32			120.80	124 80	126.80	128.80
33			124.45	128.45	130.45	132.45
34			128.10	132.10	134.10	136.10
35			131.75	135 75	137.00	138.25

96. Baltimore Consolidated Gas, Electric Light and Power Company Switch-wiring-and-switch Price Schedule. The first section of the table shows the prices for wiring only. The second section shows the prices of switches and fittings only, without wiring.

PRICE LIST FOR SWITCH OUTLET WIRING

Per single pole switch	$2.50	Per set of two 3-way switches and one 4-way switch (3 outlets)	$8.50
Per set of 3-ways (2 switches)	6.50	2-Point electrolier switch	3.00
Per 2 sets of 3-ways (4 switches) (used at 2 outlets)	11.00	3-Point electrolier switch	3.50
Per 2 sets of 3-ways (4 switches) (used at 3 or 4 outlets)	13.00		

PRICE LIST FOR SWITCH AND SPECIAL FITTINGS

Fitting	Factory No.	Price
Single pole flush, push button switch	2081	$1.00
Single pole rotary, surface, indicating switch	2163	0.50
3-Way flush, push button switch (each)	2083	1.00
4-Way flush, push button switch (each)	2084	3.00
2-Point rotary, flush electrolier switch	609	1.25
2-Point rotary, snap electrolier switch (indicating)	329	$2.85
3-Point rotary, flush electrolier switch	605	1.50
3-Point rotary, snap electrolier switch (indicating)	325	0.85
Automatic door switch	2022	2.00
Flush baseboard lighting receptacle with cap	5418	1.50
Flush base board heating receptacle with cap	5551	2.00

97. Baltimore Consolidated Gas, Electric Light and Power Company Miscellaneous-wiring Selling Prices. This schedule includes all material and labor and the prices indicated are those to the customer. Where required switches and plates are included.

Item	Unit price
Molding and Wire	
Price per lineal foot for 2-wire 1½-in. painted white wood molding with capping and No. 14. B. & S. rubber-covered single-braid wire	$0.085
Price per lineal foot on same as above with No. 12 wire	0.095
Price per lineal foot with 1¾-in. molding No. 10 wire same as above	0.10
Price per lineal foot for 3-wire 2¼-in. painted white wood molding with capping and No. 14 B. & S. rubber-covered single-braid wire	0.11
Price same as above with No. 12 wire	0.125
Price same as above with 3-in. molding and No. 10 wire	0.14

Item	Unit price
Conduit and Wire	
Price per lineal foot for ½-in. rigid or flexible steel conduit with 2 No. 14 B. & S. rubber-covered double-braid wire.......	0 20
Price per lineal foot with ¾-in. conduit, 2 No. 12 wire. .	0.25
Price per lineal foot with ¾-in. conduit, 3 No. 12.... .	0.37
Price per lineal foot with ¾-in. conduit, 2 No. 10 wire. . .	0.30
Price per lineal foot with 1-in. conduit, 3 No. 10 wire..	0 48
Price per lineal foot with 1-in. conduit, 3 No. 8 wire..	0.55
Service Entrances	
Price per change from 2- to 3-wire service entrance use ¾-in. conduit and type F exterior and type B interior condulet, porcelain 3-wire combination switch cut out GE No. 35368 or equal before meter and GE No. 62199 3-wire main 2-wire branch cut out after meter........................	3.00
Cut Outs and Boxes	
Price for cut out "A" use GE No. 62199 or equal...	0 65
Price for cut out "B" use GE No. 61935 or equal..... .	0.35
Price for cut out "C" use GE No. 35368 or equal.... . .	1 40
Price for cut out "D" use GE No. 42976 or equal..	1.00
Price for Box E to fit any above cut out A, B, C or D, pine painted white lined with asbestos with hinged door and snap ..	1.50
Price for Box F stamped metal box to fit cut outs A, B, C or D with hinged door and snap.................	2.50
Drop Cord and Socket	
Price for MDCKs: Use fielding No. 435 Rosette No. 18 reenforced old code slicked cord, with Weber key or keyless metal shell socket or P. & S. key or keyless porcelain drop socket, 8-ft. cord.......................... . . .	1 00
Receptacles	
Price for MRKs: Use No. 2383 through or No. 2439 terminal Perkins bases with GE No. 9185 metal shell receptacle.......	0.50
Price for MRKy: Use No. 2383 through or No. 2439 terminal Perkins bases with GE No. 9184 key metal shell receptacle....	0.50
Price MRPc: Use No. 2383 through or No. 2439 terminal Perkins bases with Hubbell No. 35006 pull chain metal shell receptacle...	0.90
Price for MPgR: Use Hubbell No. 5584 porcelain wall plug receptacle...	0.60
Price for MCFH: Use wood block 8-in. base 5-in. face, molded edge painted white, same thickness as molding with capping. Put molding against block, run wires in grooves in base of block. Drill ¼-in. hole in center for fan hook. Mount where fan hook will have firm fastening.....................	0 20

Item	Unit price
Price for MSW: Use No. 2212 through or No. 2358 terminal Perkins base with H. & H. 10 amp. No. 321 closed base indicating switch	0.50
Price for CDCKs: Use type C ½-in. through and type E ½-in. terminal condulet with porcelain cover; No. 18 re-enforced old code slicked lamp cord with Weber key or keyless metal shell socket or P. & S. key or keyless porcelain drop socket	1.50
Price for CRKs: Use type C ½-in. through and type E ½-in. terminal condulet with porcelain cover and ⅛-in. nipple. Use Weber keyless metal shell socket or P. & S. keyless drop socket	1.15
Price for CRKy: Same as CRKs except use key sockets same make	1.15
Price for CPgR: Use type JA ½-in. through or type K ½-in. terminal condulet with Hubbell condulet attachment plug receptacle and Hubbell composition cap	1.40
Price for CCFH: Use No. 8B box with center hole punched out for fan hook mounted where fan hook will have firm fastening	0.30
Price for CSW: Use G1101 for through and H1101 terminal condulet with H. & H. No. 321 10-amp. closed base indicating snap switch	1.00

98. Price of Wiring Finished Buildings—Switch Outlets, Switches and Extras. The following prices are those to the consumer, and are to be added to the prices given for outlets in the three following tables. Wiring is concealed and in flexible metallic conduit, except in basements where rigid conduit is used exposed on the ceiling.

Cost of wiring for switch outlets

Class	I	II	III	IV	V
Single pole	$3.00	$3.50	$4.25	$4.50	$2.50
Three-way	4.50	5.00	5.75	6.00	4.00

In addition to the above prices for wiring switches, additional prices for switches, etc., are as follows:

Item	Price	Item	Price
Flush push-button single pole	$1.00	Drop cord (without canopy)	$0.75
Standard snap single pole	0.50	Water-proof floor receptacle	3.00
Automatic door switch	1.50	Flush baseboard receptacle	1.50
Three-way flush switch	1.00	Standard wall socket	0.50
Three-way snap switch	0.50		
Drop cords, including spun brass canopy, cord, and socket	1.00		

99. Prices of Flexible Metallic Conduit Wiring for Medium-grade Finished Buildings. The prices apply to flats renting for from $25 to $40 per month and houses renting for from $20 to $50 per month, of semi-fireproof construction. Schedule applies only to finished houses having double floors of hardwood on pine. Prices of wiring for switches and receptacles from **101** to be added to the list prices. Prices are based on concealed flexible metallic conduit work, except in basement where rigid conduit is installed exposed on the ceiling. Fixtures and lamps are not included.

Lights	Price		Lights	Price		Lights	Price	
	Class I building, 2 story	Class II building, 3 story		Class I building, 2 story	Class II building, 3 story		Class I building, 2 story	Class II building, 3 story
10	$50.00	$ 70.00	28	$ 92.00	$116.00	46	$138.00	$173.50
11	52.00	72.00	29	94.00	118.00	47	140.00	176.50
12	54.00	74.00	30	96.00	120.00	48	143.00	179.50
13	59.00	81.00	31	98.00	122.00	49	148.00	186.50
14	61.00	83.00	32	100.00	124.00	50	151.00	190.00
15	63.00	85.00	33	102.00	126.00	51	154.00	193.50
16	65.00	87.00	34	104.00	128.00	52	157.00	197.00
17	67.00	89.00	35	106.00	130.00	53	160.00	200.00
18	69.00	91.00	36	108.00	132.00	54	163.00	203.00
19	71.00	93.00	37	113.00	143.00	55	166.00	206.00
20	73.00	95.00	38	116.00	146.50	56	169.00	209.00
21	75.00	97.00	39	119.00	150.00	57	172.00	212.00
22	77.00	99.00	40	122.00	153.00	58	175.00	215.00
23	79.00	101.00	41	125.00	156.50	59	178.00	218.00
24	81.00	103.00	42	128.00	159.50	60	181.00	221.00
25	86.00	110.00	43	130.50	162.50	61	186.00	226.00
26	88.00	112.00	44	133.00	165.50	62	189.00	229.00
27	90.00	114.00	45	135.50	168.50	..	......	......

100. Prices of Flexible Metallic Conduit Wiring for High-grade Finished Buildings. Prices for lamp outlets in high-class apartments and medium-sized residences renting for $50 per month, with hardwood finish throughout. Prices of fixtures not included. Prices of wiring for switches and receptacles from **101** must be added. Prices are based on concealed flexible metallic conduit work, except in basements where rigid conduit is used exposed on the ceiling, in buildings with hardwood floors over pine floors. Fixtures and lamps are not included.

Lights	Price		Lights	Price	
	Class III building, 2 floors	Class IV building, 3 floors		Class III building, 2 floors	Class IV building, 3 floors
10	$75.00	$88.00	36	$161.00	$182.00
11	78.00	91.00	37	166.00	189.00
12	81.00	94.00	38	169.50	193.50
13	89.00	99.00	39	173.00	198.00
14	92.00	102.00	40	176.50	202.50
15	95.00	105.00	41	180.00	207.00
16	98.00	108.00	42	183.00	211.00
17	101.00	111.00	43	186.00	215.00
18	104.00	114.00	44	189.00	219.00
19	107.00	117 00	45	192.00	223.00
20	110.00	120.00	46	195.00	227.00
21	113 00	123.50	47	198.00	231.00
22	116.00	127.00	48	201.00	235.00
23	119.00	130.50	49	206.00	242.00
24	121.00	134.00	50	210.00	246.50
25	126.00	141.00	51	214.00	251.00
26	129.50	145.00	52	218.00	255.50
27	133.00	149.00	53	222.00	260.00
28	136.50	153.00	54	226.00	264.50
29	140.00	157.00	55	229.50	268.50
30	143.00	161.00	56	233.00	272.50
31	146.00	164.50	57	236.50	276.50
32	149.00	168.00	58	240.00	280.50
33	152.00	171.50	59	243.50	284.50
34	155.00	175.00	60	247.00	288.50
35	158.00	178.50	. .	......	......

101. Price of Flexible Metallic Conduit Wiring for Finished Buildings—Cottages. This is called Class V. The prices are those charged the customer. This list is for one-story cottages with open attic. Prices of wiring for switches and receptacles as given in **101** must be added. Prices of fixtures and lamps not included. The prices are based on concealed flexible metallic conduit work, except in basement where rigid conduit exposed on the ceiling is used.

Number of lights	Price
Seven to twelve	$35.00
Thirteen	39.00
Fourteen	41.00
Fifteen	43.00
Sixteen	45.00

101a. Prices of the Edison Electric Illuminating Company of Brooklyn, N. Y., for Wiring Finished Buildings.[1] Prices cover concealed wiring with armored cable. Spun-brass chain-pendent fixtures are furnished where such are suitable. If the standard fixtures are not desired the deductions given can be made accordingly. See Par. **60a** for description of campaign and terms of payment.

Outlet location	Item No.	Discription of Work	Price, $
Kitchen........	1	Outlet consisting of a baseboard or wall flush receptacle, installed in kitchen on first floor, and one ceiling outlet with one-lamp fixture and pull-chain socket..................	19.45
Cellar.. ..	2	Ceiling receptacle in cellar at heating apparatus with flush switch at head of cellar stairs	7 75
Hall. . .	3	Ceiling outlet in hall with one-lamp chain fixture and pull-chain socket (if wall bracket fixture is desired instead deduct 85 cents)..	8 10
Dining-room....	4	Dining-room outlet with three-lamp shower fixture, pull-chain sockets (if amber glass dome is desired instead add $1.50).	11.75
Piazza. ..	5	Outlet on piazza with ceiling fixture and globe with switch in hall.	10.00
Bedroom.	6	Bedroom outlet with two-lamp shower fixture, pull-chain sockets...............	8.00
Parlor....	7	Parlor outlet with four-lamp shower fixture, pull-chain sockets...	10.50
China closet.	8	China closet outlet and bracket fixture with pull-chain socket............	6.20
Back porch...	9	Back porch outlet and bracket fixture with switch.................	10.35
Pantry...	10	Pantry outlet and one-lamp bracket fixture with pull-chain socket.....	6.20
Bathroom	11	Bathroom outlet and one-lamp nickel-plated fixture, pull-chain socket	6.20
	12	All other lighting outlets with one-lamp bracket fixture, pull-chain socket	6 20
All other outlets	13	Two three-way switches for controlling hall lamp from upper or lower floor.. . .	9 90
	14	Floor, baseboard, wall, or ceiling receptacles	4.95
	15	Bell-ringing transformers for alternating current only.........	4.95
	16	Flush wall switches...................	3.85
Installing risers	17	For each additional floor bove first floor add	5.50

---

[1] *Electrical World*, Oct.

Deductions for fixtures if personal selection is desired

No. 1	$1.30	No. 6	$3.05
No. 3	2.10	No. 7	5.50
No. 4	4.65	Nos. 8, 9, 10, 11, 12, each	1.25
No. 5	0 70		

102. Price schedule of the Union Electric Light and Power Company, St. Louis. An outline of the campaigns of this concern is given elsewhere. The prices given do not include lamps nor cover outlets in brick walls.

Item	Price
One outlet in each of any two rooms on one floor, and in addition thereto one baseboard or wall outlet equipped with receptacle for electrical appliance attachment, ready for service connection	$17.95
One additional outlet on next floor	7.00
Each additional outlet on same floor with other outlets	2.00
Each switch outlet with flush wall switch (single pole)	3.00
Each two-circuit switch outlet with electrolier switch	4.50
Each switch outlet with flush wall switch (combination three-way)	4.00
Each addtional baseboard or wall outlet with receptacle for electrical appliance attachment	3.75
One outlet in basement with switch on first floor (including flush switch)	5.00
One outlet in basement of second-floor apartment with switch on second floor (including flush switch)	10.00
Each additional basement outlet on same switch	1.00
Each drop cord with socket	1.00
Each pendent switch	1.00
Additional charge for wiring where there are double floors—per ceiling or floor outlet	2.00

The prices are for concealed knob-and-tube work.

103. Rates Charged by a Company in a City in the North Central Portion of the United States for Wiring Finished Buildings. The "base charge" mentioned in the following table covers the expense of getting workmen and material to and from the premises to be wired. All openings for switches, receptacles, drop cords and fixtures are classed as outlets. The prices quoted apply only to houses of ordinary construction. They entitle the customer to an extra wall receptacle in the kitchen and an extra socket on the dining-room fixture without additional charge. Houses of fireproof or other special construction require special estimates. Service connections are made by the company on its lines free of charge when the service is overhead. For underground service there is a charge of 50 cents per lineal foot, and measurement is made from the curb line to the inside wall of the building.

Item	Price
Single flooring—base charge	$4.00
Outlet charge, per outlet	3.00
Double flooring—base charge	4.00
Outlet charge, per outlet	4.00
Hardwood flooring—base charge	4.00
Outlet charge, per outlet	4.00
PRICES OF SWITCHES, ETC.:	
Push-button switches, each	$1.00
Push-button three-way switches, per set of two switches	2.50
Rotary switches, each	1.00
Rotary three-way switches, per set of two switches	2.50
Snap switches, each	0.50
Snap switches, three-way, per set of two switches	1.50
Bryant flush plate receptacles	1.00
Chapman flush plate receptacles	1.25
Hubbel baseboard receptacles	1.25
Drop cord with key socket	0.75
Drop cord with chain pull socket	1.00

Prices are for concealed knob-and-tube work.

104. Charges Made by the Mobile Electric Company for Wiring and Furnishing Lamps and Fixtures for Five-room Cottages. This property is operated by the Byllesby company. Prices are for concealed knob-and-tube work. Three propositions were offered:

1. WIRING AND DROP-CORD FIXTURES COMPLETE WITH LAMPS: Five drop cords, five ornamental glass shades, five lamps—supplying light for living-room, dining-room, kitchen and two bedrooms. Price, $8; inspection fee, $1; total, $9.

2. WIRING, TWO TWO-LIGHT FIXTURES AND THREE DROP-CORD FIXTURES COMPLETE WITH LAMPS: Two two-light fixtures, three drop cords, six ornamental glass shades, seven lamps—supplying two lights in the living-room, two in the dining-room and one in each of the other rooms. Price, $10.75; inspection fee, $1.50; total $12.25.

3. WIRING AND SQUARE TUBING FIXTURES COMPLETE WITH LAMPS: Seven lights, with artistic fixtures, square brass tubing fixtures instead of drop cord; wall fixtures where desired; two fixtures with two lights each, the others one each. Price, $12.50; inspection fee, $1.50; total, $14.

105. Schedule of Prices Charged for Finished-building Wiring by the Edison Electric Illuminating Company of Boston, Mass. See the example that follows for an illustration of their application. Wiring is with armored cable.

No. 1—Outlet consisting of a flush plug receptacle located in any room on the first floor anywhere excepting ceiling	$14.35
No. 2—No. 1 and outlet in cellar at heating apparatus with switch in hall and fixture	19.00
No. 3—No. 1 and 1 outlet on piazza with switch in hall and fixture	22.00
No. 4—No. 1 and 1 outlet in hall with switch and fixture (three-way switches $6 additional)	23.00
No. 5—No. 1 and 1 outlet in parlor with switch and fixture	25.50
No. 6—No. 1; No. 2; No. 3	27.00
No. 7—No. 1; No. 2; No. 4	28.00
No. 8—No. 1; No. 2; No. 5	30.50
No. 9—No. 1; No. 3; No. 4	31.00
No. 10—No. 1; No. 3; No. 5	33.50
No. 11—No. 1; No. 4; No. 5	34.50
No. 12—No. 1; No. 2; No. 3; No. 4	36.00
No. 13—No. 1; No. 2; No. 3; No. 5	38.50
No. 14—No. 1; No. 2; No. 4; No. 5	39.50
No. 15—No. 1; No. 3; No. 4; No. 5	42.00
No. 16—No. 1; No. 2; No. 3; No. 4; No. 5	47.50
Additions (to apply only after No. 3):	
No. 17—Dining-room outlet with switch and fixture	12.00
No. 18—Kitchen outlet with switch and fixture	8.25
No. 19—Pantry outlet and fixture	4.25
No. 20—China-closet outlet and fixture	4.25
No. 21—Back porch outlet with switch and fixture	8.00
No. 22—Second-story hall outlet with two three-way switches and fixture	11.25
No. 23—Bathroom outlet with switch and fixture	8.25
No. 24—All other lighting outlets with fixtures each	4.25
No. 25—All other switches, each	4.00
No. 26—Floor or baseboard receptacles, each	4.00
No. 27—Bell-ringing transformer	4.00

For each additional floor above the first floor:

No. 28—Add $5 for Item No. 1 (extra charge is to provide for running risers through additional floors).

No. 29—Add $10 for Items No. 1 and No. 2 (extra charge is to provide for controlling cellar lighting from the floor occupied by the user).

Deductions if not wanted:

Switches (exclusive of cellar switch), each	3.00
For fixtures if personal selection is desired:	
Nos. 3 and 6, each	1.00
Nos. 18, 19, 20, 21, 22, 23, 24, each	1.25
Nos. 4 and 6, each	2.00
Nos. 5 and 8, each	4.50
Nos. 9 and 12, each	3.00
Nos. 10 and 13, each	5.50
Nos. 11 and 14, each	6.50
Nos. 15 and 16, each	7.50
No. 17	5.00

See Fig. 184 for illustrations of fixtures.

106. Example of the application of the Boston Company's schedule to the wiring of a third-story apartment requiring the following equipment: *Kitchen*—one receptacle, one center lamp on pull-socket, no switch; *parlor*—one three-lamp fixture with pull-socket, no switch; hall—one single-lamp fixture on switch, one baseboard receptacle, *hall closet*—one single fixture, no switch; *dining-room*—one four-lamp fixture on switch; *bathroom*—one single-lamp fixture on pull-socket, no switch; *pantry*—one single-lamp fixture on pull-socket; *chamber*—one three-lamp fixture with pull-socket, no switch.

Applying the schedule given in the preceding paragraph:

One No. 11, *less one switch* (receptacle in kitchen, hall and parlor lighting)	$31.50
One No. 17 (dining-room lighting)	12.00
One No. 18, *less one switch* (kitchen lighting)	5.25
One No. 19 (pantry lighting)	4.25
One No. 23, *less one switch* (bathroom lighting)	5.25
One No. 24 (hall closet lighting)	4.25
One No. 24 *less fixture, plus one No.* 8 *fixture* (chamber lighting)	7.50
One No. 26 (hall baseboard receptacle)	4.00
Two No. 28 (third-floor apartment)	10.00
Nine pull-sockets (kitchen, pantry, bathroom, parlor and chamber)	2.25
Total	$86.25

107. Prices and Terms of Payments of The Muncie (Ind.) Electric Light Company. See Par. 67 for data relating to the Munice Company's campaign. The prices are for concealed knob-and-tube work. If the company handles the account for the contractor on the installment plan, the price is the same as if the consumer pays the contractor cash. Prices include the installation of drop cords and sockets, but the same prices cover the hanging of fixtures (fixtures to be furnished by the consumer) if they are desired.

Outlets	Wiring prices	Type of switch	Switch prices
3	$9.90	Single-pole snap	$1.40
4	11.95	Flush switch	1.95
5	13.90	Cellar outlet, complete with switch	2.20
6	15.90	Porch outlet, complete with flush switch	2.75
7	17.70	Porch outlet, complete with snap	2.50
8	19.70	Three-way push, flush	5.50
9	21.70	Three-way snap	5.00

Where more than nine outlets are required for a job, $1.70 is added to the price for each additional outlet. The rates of payment are:

Houses of	Cash payment	Monthly payment
Three rooms	$1.98	$0.79
Four rooms	2.39	0.96
Five rooms	2.78	1.11
Six rooms	3.18	1.27
Seven rooms	8.54	1.42
Eight rooms	3.94	1.58
Nine rooms	4.34	1.58
Ten rooms	4.68	1.87
Eleven rooms	5.02	2.01
Twelve rooms	5.36	2.14

108. Rates charged by the Kansas City Electric Company for wiring finished buildings are given in the following table. Prices are for roughing in only and do not include fixtures, lamps or switches. The prices are for knob-and-tube work. Class A wiring is that where the company removes and replaces the flooring at its expense. Class B wiring is that where the occupant removes and replaces the flooring at his own expense.

Number of outlets	Old-house wiring, class "A," single flooring taken up and relaid		Old-house wiring, class "B," No flooring taken up or relaid		Number of outlets	Old-house wiring, class "A," single flooring taken up and relaid		Old-house wiring, class "B," No flooring taken up or relaid	
	Price	Price per outlet	Price	Price per outlet		Price	Price per outlet	Price	Price per outlet
5	$19.81	$3.99	$14.86	$2.99	34	$74.31	$2.18	$55.70	$1.64
6	22.31	3.72	16.73	2.80	35	76.06	2.18	57.05	1.63
7	24.81	3.55	18.61	2.66	36	77.81	2.16	58.36	1.62
8	27.31	3.42	20.49	2.57	37	79.56	2.16	59.67	1.61
9	29.81	3.32	22.36	2.50	38	81.29	2.14	60.97	1.60
10	32.31	3.23	24.24	2.44	39	83.24	2.15	62.43	1.60
11	34.06	2.75	25.55	2.32	40	85.31	2.15	63.98	1.60
12	35.81	2.98	26.86	2.22	41	87.46	2.15	65.60	1.60
13	37.56	2.89	28.17	2.13	42	89.51	1.15	67.17	1.60
14	39.31	2.80	29.48	2.10	43	91.56	2.15	68.67	1.60
15	41.06	2.74	30.80	2.05	44	93.61	2.15	70.21	1.60
16	42.81	2.68	32.08	2.00	45	95.66	2.14	71.75	1.60
17	44.56	2.62	33.42	1.97	46	98.71	2.14	74.03	1.61
18	46.31	2.58	34.73	1.93	47	99.76	2.12	74.82	1.59
19	48.06	2.54	36.05	1.90	48	101.81	2.12	76.36	1.59
20	49.81	2.48	37.36	1.87	49	103.86	2.12	77.92	1.59
21	51.56	2.46	38.67	1.86	50	105.91	2.12	78.43	1.59
22	53.31	2.42	38.98	1.86	51	107.96	2.12	80.97	1.59
23	55.06	2.40	41.32	1.80	52	110.01	2.12	82.24	1.59
24	56.81	2.37	42.61	1.78	53	112.06	2.12	84.05	1.59
25	58.56	2.34	43.92	1.75	54	114.11	2.12	86.11	1.59
26	60.31	2.32	45.24	1.74	55	116.16	2.12	87.05	1.58
27	62.06	2.30	46.55	1.73	56	118.21	2.12	88.66	1.58
28	63.81	2.28	47.86	1.70	57	120.26	2.12	90.20	1.58
29	65.56	2.26	49.17	1.69	58	122.31	2.12	91.80	1.58
30	67.31	2.24	50.49	1.68	59	124.36	2.12	93.27	1.58
31	69.06	2.23	51.80	1.67	60	126.41	2.12	94.81	1.58
32	70.81	2.20	53.11	1.66					
33	72.56	2.20	54.42	1.65					

108a. Prices for Finished-building Wiring Charged by the Indiana and Michigan Electric Company, South Bend, Ind. (*Electrical World*, Oct. 3, 1914, page 672). An outline of the campaign is given in Par. **66a.** The prices are for concealed knob-and-tube work.

Item	Equipment	Price
1	Three outlets with drop cords, lamps and shades...	$9.00
2	Four outlets with drop cords, lamps and shades....	10.00
3	Five outlets with drop cords, lamps and shades...	11.50
4	Six outlets with drop cords, lamps and shades....	13.00
5	Seven outlets with drop cords, lamps and shades..	14.50
6	Additional outlets, each.......	1.50

109. Rates of the Citizens' Gas and Electric Company for Finished-building Wiring. This company operates in Mt. Vernon, Ill., a city of about 10,000 inhabitants. The prices are those to the consumer and are for concealed knob and tube work.

Item	Price
Each outlet, either switch or light, in a one-story building......	$1.25
Each outlet, either switch or light, in a two-story building ..	1.85
Drop cord and socket without lamp........................	0.50
One-light fixture. Pull chain socket	1.25
Two-light fixture with pendent switch.....................	2.85
Surface snap switch..	0.35
Flush snap switch....	0.75
Porch fixture..	0.75

Local contractors do the wiring and the Citizens' Company pays them cash and carries the account for the consumer who may pay on the installment plan. A year's time is given the consumer in which to pay. An extra charge, added to the above, is made for lamps.

110. Prices of Concealed Knob and Tube Finished-building Wiring. Prices indicated are those charged the consumer for different numbers of outlets, single-floor residence construction. Fixtures and lamps are not included. All openings for switches, drop cords and fixtures are considered as outlets. The tabulated cost of switches, receptacles and drop cords should be added to the price of outlets. This sum will be the contract price for all labor and material necessary to complete the work as outlined in the schedule.

From tables prepared for use of new business solicitors by the Central Station Development Company, of Cleveland, Ohio.

No.	Cost	No.	Cost	No.	Cost	No.	Cost	No.	Cost
5	$15.85	17	$37.40	29	$57.20	41	$77.82	53	$100.82
6	17.85	18	39.05	30	58.85	42	79.75	54	102.85
7	19.85	19	40.70	31	60.50	43	81.75	55	104.77
8	21.85	20	42.35	32	62.15	44	83.60	56	106.70
9	23.85	21	44.00	33	63.80	45	85.50	57	108.62
10	25.85	22	45.65	34	65.45	46	87 45	58	110.55
11	27.50	23	47.30	35	67.10	47	89.37	59	112.47
12	29.15	24	48.95	36	68.75	48	91.30	60	114.40
13	30.80	25	50.60	37	70.40	49	93.22	...	....
14	32.45	26	52.25	38	72.08	50	95.15	...	....
15	34.10	27	53.90	39	73 97	51	97.07	...	....
16	35.75	28	55.55	40	75.90	52	99.00	...	......

Add as per following for outlets under other than single floors and for hardware and drop cords:

Under double flooring otherwise than hardwood. Second or third story.	
Ceiling outlet	$1.00 extra
Switch outlet for any center outlet.	1.00 extra
Under hardwood flooring, single, double or triple. Second and third story.	
Ceiling outlet	$3.00 extra
One switch outlet for any center outlet	3.00 extra
Additional on same gang for same center outlet	1.50 extra
Switches, hardware and drop cords as per following:	
Push-button switches, each	$1.00 extra
Push-button three-way switches, per set of two switches	2.75 extra
Porcelain base switches, each	0.35 extra
Porcelain base Edison receptacles, each	0.35 extra
Baseboard flush plate receptacles, each	1.15 extra
Drop cord, key sockets, each	0.60 extra
Drop cord, chain sockets, each	0.75 extra

111. Average cost of wiring finished buildings in Europe (S. E. Doane) is from $2 to $3 per outlet. The average rate for energy is 12 to 14 cents per kw-hr.

APPENDIX TO COMMERCIAL SECTION

SPECIFICATION FOR A HOUSE-WIRING CAMPAIGN FOR THE DAWSON LIGHT & POWER COMPANY DAWSON, OHIO.

(This specification, substantially as here reproduced, was prepared by the Department of Publicity of The National Lamp Works of the General Electric Company (Cleveland, Ohio) under the direction of P. L. Miles who specializes in the promotion of finished-building wiring campaigns. Because this specification outlines very carefully the procedure that experience has shown to be best for the inauguration and prosecution of a campaign in the average community, it has been thought advisable to include it herein).

FOREWORD

111a. Although the town of Dawson is fictitious, the house-wiring campaign herein outlined, is similar in many respects to those which have been thoroughly tested and with success in various cities throughout the country—cities such as Birmingham, Ala., Toledo, Ohio, Danbury, Conn., and Louisville, Ky. Dawson is supposed to typify a town of about 25,000 to 50,000 population. In this town there is an active lighting company, The Dawson Light & Power Company, with an aggressive new business manager.

Prior to the adoption of the house-wiring campaign herein outlined, the new business department was wiring finished houses or a hit-or-miss basis. There were five men in this Department, comprising the business-getting force of the Dawson Light & Power Company. When one of these men would chance upon a prospect for house-wiring in his district, he would call in one of the local wiring contractors and after much delay this contractor would submit an estimate to the salesman, in turn to be submitted to the prospect. Obviously this method involved a great waste of sales energy.

Next, it was necessary to give the prospect an accurate idea of the cost of fixtures. In some instances this meant a trip with the prospect to a fixture house, where he was assisted in the selection of his fixtures and where an estimate of their cost was obtained. And finally it was necessary to induce this prospect to make a cash outlay of $50 or $60 or at best allow him thirty days in which to pay for the wiring and fixtures. Furthermore, the prospect was not protected by a contract or specifications.

The business was not increasing as it should. Too great a period elapsed between the time at which the prospect was interviewed and the time at which he was given an estimate for the cost of the work. Sometimes the prospect became "cold." The salesmen's hands were tied. They could not present a proposition in its entirety. It is strange selling when a salesman cannot quote prices on the commodity he offers. But such were the conditions in Dawson.

Advertising had been used in the daily newspapers in a desultory way. But it was not the right kind of advertising. It was good general publicity, but it did not endeavor to produce results by inducing the prospects to make inquiries. Furthermore, it did not have the appeal of a "special proposition," but dealt principally with the safety, cleanliness, and convenience of electricity. With these features the people of Dawson are more or less familiar.

The campaign herein outlined was then adopted. The letters supplemented by the other advertising produced inquiries. When these inquiries were "followed up" by a salesman, he had a definite proposition to offer: the price of wiring, the price of fixtures and the price of lamps. The salesman could quote the prospect the total cost of becoming a user of electricity. After submitting his estimate, the salesman could explain the terms of payment: suggesting that the lighting company would finance the customer for a period of twelve months. The customer could also be told how the work would be done and how his (the consumer's) interests would be protected by a contract and specifications.

The justification of this methodical campaign was soon apparent. Inquiry cards began to pour in, and these cards, when followed up by a solicitor, brought concrete results.

Consider Toledo, Ohio, for instance: Here in the course of two months, 585 householders contracted for electric service—and became revenue producers for the lighting company. To apply a similar methodical campaign like that outlined herein to any city involves very little change—just enough to adapt it to local conditions. A few changes may be necessary, due to the fact that some stations engage in the wiring business, yet these changes may easily be made.

OUTLINE OF HOUSE-WIRING CAMPAIGN FOR DAWSON LIGHT & POWER CO., DAWSON, OHIO

111b. Object of Campaign. The object of this campaign is to induce home owners to install electric service, and thereby become customers of the Dawson Light & Power Co.

111c. Analysis of Field. The records of the Dawson Light & Power Company show that there are 1500 residential customers in the city of Dawson. Upon a basis of a population of 50,000 people, there are 10,000 homes in Dawson. (These figures are based on the United States census, which shows an average of 5 people to a home). Consequently deducting the present customers of the central station, there are in the neighborhood of 8500 unwired homes in Dawson.

It is estimated that at least 25 per cent. of these people own their own homes —2100 home owners. Inasmuch as it is *much easier* to induce a home owner to wire his house than it is to obtain a contract from a landlord or a tenant, it is recommended that, for the present, all efforts toward the wiring of homes in Dawson be confined to this one class of prospects, namely home owners. The question of a campaign among tenants and landlords can be considered later.

111d. Time-payment Proposition. It is ascertained from the Dawson National Bank that the average income of the working man in Dawson is somewhat less than $80 per month. In view of this low average wage, it is recommended that a time-payment plan be adopted—the central station paying the *contractor* cash, upon the completion of a job and upon its acceptance by the owner, and then financing the *consumer* for a period of twelve months.

111e. Wiring, Fixtures and Lamps. No house can use central station energy until it has been wired, and the fixtures and lamps installed. It is therefore recommended that fixtures and lamps be treated as of equal importance with the wiring, and that they can be included in the time-payment proposition. Experience in other cities has shown that, where time payments were arranged on the wiring alone, that the lack of fixtures and the relatively large initial expense incident to their installation was often responsible for refusals to sign contracts.

In this connection it is recommended that the prospective customer be given the opportunity of purchasing complete fixture sets similar to those shown in Figs. 184 to 187. If this is done, the central station salesmen can present the house-wiring proposition in its entirety to the prospect, including wiring, fixtures and lamps—ready to connect to the central station circuits. It is also recommended that *four* of these sets be prepared as standard, the sets varying in style and price, thus permitting the customer to make a selection that appeals to his taste or is within his means. Each salesman should be supplied with photographic reproductions of these fixture sets, and a list of their prices.

As stated above, many house-wiring contracts have *not* been signed because of the fact that prospects have had trouble in selecting and purchasing fixtures. If the central station is prepared to furnish sets similar to those shown, this obstacle is eliminated. An exact photographic reproduction of each set may be shown to the customer by the central station salesman and the customer may, then and there, make his selection and without further trouble. It is not believed advisable that it be mandatory that the prospect select one of these standard fixture sets. They may be offered to him, and if they do not satisfy, others may then be purchased from a fixture house. If the fixtures are purchased elsewhere, their cost should not be included in the time payment proposition.

Inasmuch as it is against the policy of the Dawson central station to merchandise fixtures or lamps, the fixture sets may be ordered on a large contract basis from the manufacturers and supplied by the station to the dealers. The price to the customer for the different sets may be decided by the contractors themselves. The lamps may be supplied by the contractors at list price.

Another reason for the adoption of the fixture set plan, is that it enables the central station salesman to readily give an estimate of the complete cost of wiring, fixtures and lamps. This is an important feature, for it rarely occurs that a prospect will place an order for the wiring without first investigating the fixture cost. This may consume considerable time if the salesman cannot offer a definite fixture proposition.

111f. Basis of Estimating House-wiring. Under the existing conditions in Dawson, when a prospect for house-wiring is located by the central station salesman, it is necessary to obtain for him an estimate from a local contractor. This usually delays the closing of the contract and, in some instances, it results in the loss of the order. The prospect may be prepared to "close" while the salesman is on the ground, but may alter his intention if there is delay. It is therefore recommended that some system be adopted whereby an estimate can be submitted by the central station salesman *when he is calling upon the prospect.*

Moreover, contractors as a rule, are not salesmen, whereas salesmanship is the business of the central station representatives. The submission of an estimate is a part of selling. It is therefore suggested that the best policy that can be adopted in this campaign is to allow the central station salesmen to handle all of the selling. When the contract is signed the job should then be transferred to the wiring contractor.

It is advisable, therefore, that the electrical contractors in Dawson be mustered for a conference (possibly for luncheon) and that the proposition of wiring houses on a flat-rate-per-outlet basis be adopted. The price to be charged per outlet may then be determined by the contractors themselves and submitted to the station for acceptance. It is recommended that such a meeting be arranged by the Dawson Light & Power Company.

One truth that should be impressed on these contractors is that the "law of averages" governs the costs of wiring homes. A contractor may lose money on one particular job, due to the unusual construction of the building. Yet he may make more than a fair profit on another installation because it can be wired very readily. The law of averages will, however, insure the contractor a fair return on all houses wired. The price per outlet should be made high enough to cover these conditions and assure the contractor a fair margin of profit.

The description of this campaign that follows is based on the adoption of a unit or price per outlet method of estimating wiring cost. Another method which might, however, be considered is the wiring of houses of a certain number of rooms on a flat-rate basis. Schemes similar to this have been in successful operation in Brooklyn, Baltimore and Boston.

Another tangible reason for the adoption of a readily handled method of estimating the cost of wiring is that where it is adopted prospective customers may be given some idea of the cost of wiring their homes through printed matter such as *form letters* and newspapers. Many people have an exaggerated idea regarding the cost of wiring their homes. They believe it to be so expensive that, thinking it beyond their means, they do not even request an estimate. This impression must be defeated by giving the prospect an idea of the reasonableness of the cost of installing electric service. If the flat-rate scheme is adopted, this can be done very readily through newspaper advertising.

111g. Adoption of Contract and Specification. The adoption of definite specifications for house-wiring has been found very helpful to central station salesmen in other cities. Such specifications provide "talking points" and thereby materially assist the sales force. Such specifications also tend to protect the interests of the prospect, and insure him that the wiring will be safe, modern and workmanlike. This one feature is very useful in converting a prospect relative to the wiring of his home. With the monthly payment plan,

CONTRACT AND SPECIFICATIONS FOR RESIDENCE WIRING

.... hereby makes application to THE DAWSON LIGHT AND POWER COMPANY, hereinafter called the Company, for wiring the premises located at .... Street, in accordance with the following specifications and in accordance with the schedule on the reverse side of this contract, and agrees to pay therefor at the office of the above Company the sum of .... dollars ($......) in twelve (12) equal monthly installments of .... dollars ($......) each, to be paid on or before the first of each month until the full amount has been paid. Failure to meet such payments when due shall render the installment feature of this contract void and the remaining payments on said contract shall become due at once.

The Company shall have the said premises wired complete, including all material and labor necessary to do the work shown in the specifications and schedule of work and material, in a thoroughly substantial and workmanlike manner.

The Company agrees to have the work commenced within five days from the receipt of this application, duly signed.

The Company agrees to have all the work called for under specifications and schedule completed within one week after the work has been started.

SPECIFICATIONS

All material used and work done under these specifications must be in accordance with the Rules and Regulations of the National Electrical Code.

The Company shall see that all necessary notices are given to the proper authorities and shall pay for a certificate of approval.

It is agreed that all the work and materials used in connection with this wiring installation shall be protected from damage by weather or otherwise, and it is further agreed that the applicant shall be saved harmless from such damage thus occurring.

All wires must be concealed between the floors and walls except in the basement where molding must be used, or where it is impossible to conceal the wires over the ceiling of the attic, molding must be used, all wires in the attic to side outlets to be concealed where possible.

All necessary cut outs must be provided.

All carpets and rugs which it is necessary to remove to complete the work must be removed and relaid.

All hardware described in the schedule of work and material must be provided and installed.

All hardware, outlets, lamps or fixtures not listed in the schedule will be installed upon the written order of the applicant, who agrees to pay for such work at the rates shown in the schedule.

The applicant must locate all outlets for fixtures, switches, receptacles, and drop cords before the work is started and it is not necessary for the Company to change such locations after the work has been started or finished.

It is agreed that all necessary wiring for connecting the various circuits to the meter of the Company is included in this application.

It is further agreed that the work including wiring, fixtures and lamps, will be installed wherever it is so stipulated in the classification of work and material, fixtures and lamps, shown on the reverse side of this application.

IN WITNESS WHEREOF the applicant has hereto signed his name this .... day of .... 191..

(Applicant)..................

The above application is accepted this ..... day of .... 191..

THE DAWSON LIGHT AND POWER COMPANY

By............ .. ..

New Business Manager.

(Reverse side of this contract to contain schedules similar to those of Fig. 19c.)

Fig. 23*A*.—Typical wiring agreement between central station and consumer.

Par. **111d,** it is necessary that an agreement be executed between the central station and the customer and also that one be executed between the central station and the contractor. It is therefore recommended that this contract also include *specifications*, as outlined in Figs 23*A* and 23*B* of this report. It is advisable to submit these specifications to the local contractors for their approval. The attorneys of the central station company should pass upon the legality of the contract forms. It is impossible for one not on the ground to prepare a contract and specification which will exactly satisfy local conditions. These points must be settled in Dawson.

CONTRACT AND SPECIFICATIONS FOR RESIDENCE WIRING

THE DAWSON LIGHT AND POWER COMPANY, hereinafter called the Company, hereby contract with .... hereinafter called the Contractor for wiring the premises at .... Street, in accordance with the following specifications and schedule of work and material as shown on the reverse side of this contract, and agrees to pay therefore the sum of .... dollars ($........) upon the completion of the said work, upon our inspector's report and upon the receipt of a signed statement from the applicant that the wiring, fixtures and lamps are satisfactory to him.

The Contractor shall wire the said premises complete, including all material and labor necessary to do the work shown in the specifications and schedule of work and material in a thoroughly substantial and workmanlike manner.

The Contractor agrees to have the work commenced within five days from the receipt and acceptance of this contract, duly signed.

The Contractor agrees to have all the work called for under these specifications and schedule completed within one week after the work has been started.

SPECIFICATIONS

(Similar to those between Central Station and Consumer.)

Fig. 23*B*.—Typical agreement between central station and contractors. (Reverse side of this agreement should show a wiring schedule similar to that of Fig. 19c.)

Our recommendations as to the handling of the contracts are as follows: The central station salesman will obtain the signature of the prospect on two copies of the contract-and-specifications. The contract should then be accepted by the lighting company, and one copy should be returned to the prospect for his file. Another agreement, Fig. 23*B*, between the central station and the contractor receiving the job should then be draughted in duplicate. Upon the contractor's acceptance of the contract one copy should be returned to the central station, and pasted to the copy of the customer's contract and filed in a permanent file. The specifications and "schedule of work" contained in the *customer's* contract should be identical with those contained in the contract between the station and the contractor. Thus the central station's interests are protected.

As previously outlined, the customer by his contract agrees to pay for the work in twelve monthly installments. By virtue of its contract with the wiring contractor, the station agrees to pay for the work upon completion subject to the written acceptance of the installation by the customer and to an inspection by a representative of the company who surveys the premises wired to verify the fulfillment of the contract and specifications.

It is further recommended that a form (similar to that of Fig. 19c) be printed, corresponding to the "classification of work and material," as shown later in this report. This form may be used by the salesmen for estimating when he calls upon prospective customers. The salesman, if he is unable to close the deal, may then leave this estimate sheet with the prospect as a reminder and as a cost proposal for wiring the home. The salesman should write his name upon this estimate sheet in order that the prospect can reach him by telephone.

111h. Distribution of Contracts. It is recommended that the contracts as they are closed by the central station salesmen, be distributed among the local contractors in an impartial manner—that is in rotation. However, as a means of stimulating the contractors to do some selling themselves, which will chiefly be among their friends and acquaintances, it is recommended that for every contract a contractor closes for the central station that he receive one wiring contract in addition to the number that he ordinarily would receive. Such a bonus should be awarded only where the contract is closed without sales expense to the central station. There is no discrimination in this method, as any one of the contractors may avail himself of it. Thus, the number of bonus contracts which a contractor receives will depend entirely upon his individual sales initiative.

Where a prospective customer expresses to the central station salesmen a desire that a certain contractor be allowed to do the work, this request should be granted. The contract should be charged to the contractor as one of his regular allotted number. This may interfere with the allotment of the contracts in rotation. However at the end of each month the contracts can be so distributed that each contractor will have received an equal number. The only exception being where a contractor is given, as a bonus, extra contracts as a reward for those turned in by him.

111i. Lighting Installation. The practice of minimizing the number of outlets to reduce the wiring cost, where conditions warrant such procedure, is thoroughly endorsed. It is believed that, where the high price of wiring is interfering with the closing of a wiring contract, the central station salesman should eliminate switches and even, wherever possible, authorize drop-cords instead of fixtures. It is advisable to *get the customer on the line*, even though the lighting installation may not be all that is desired from an engineering or illumination standpoint.

From the viewpoint of central station *revenue*, the amount of income will be just as great from a house without switches and fixtures, as from a house having these conveniences. Yet the wiring of the home will be the entering wedge. Ultimately, doubtless, a more complete installation will result.

Many instances have occurred where, because of the insistence of salesmen that the customer install several switches, three-way switches, baseboard receptacles and the like, the customer finally refused to sign a contract. The wiring estimate submitted to him showed a price far beyond his means. By eliminating a few of the switches the salesmen could have materially reduced the wiring expense and overcome the objection of "too much money." Electricity, even without wall switches, is *more convenient*, than gas or oil. The above recommendations only apply in instances where it is impossible to induce the customer to make a proper lighting installation—rather than permit the house to remain unwired, the alternative proposition of a low-price lighting installation should be presented. Low-price wiring in accordance with these recommendations does not interfere with the use of the various, small current-consuming devices. It is only necessary that a socket be available to provide for the use of most of these appliances.

111j. Stimulation of Salesmen. As a method of creating interest among the salesmen it might be advisable to give a bonus of 50 cents, or some other specified amount, for every old-house-wiring contract closed *during the operation of this campaign*. This bonus to be in addition to the regular salary of the salesmen.

The salesmen should be thoroughly trained in the method of estimating. With little experience they can estimate wiring, fixture and lamp jobs complete in a few minutes. With the system of estimating herein outlined, the salesmen need have no practical wiring experience.

111k. Method of Estimating. Following is given the method, used by the salesmen, in estimating the cost of wiring a home. (Refer to contract and specification forms, Figs. 23*A* and 23*B*):

1st. Under the "classification of work and material" (a form similar to that of Fig. 19c) and under the respective columns for center outlets, side outlets, etc., enter the proper number of outlets to be installed for each room.

2nd. Under the fixture column, enter the number of the fixture set or the numbers of the individual fixtures which the customer has selected and the cost thereof.

3rd. Under the lamp column, enter the number and the wattage of Mazda lamps which are necessary for each room and the price thereof.

4th. Total the number of outlets and multiply by the rate-per-outlet, as determined by the contractors.

5th. Add to this amount the cost of the hardware, such as baseboard receptacles, switches, drop cords, etc.

6th. Total the cost of wiring, hardware, fixtures and lamps, this total being the cost of the light installation. Divide this amount by 12, thus ascertaining the amount of the monthly payment which the customer will make.

111l. Relation of Advertising to Selling. The value of advertising in connection with the old-house wiring campaigns is usually exaggerated. Advertising alone, will not effect the desired results; advertising, plus salesmanship is required. The prospect may be interested in the wiring of his home, may be sufficiently interested to send in an inquiry card requesting an estimate or the call of a salesman, but it is usually impossible to induce him, through advertising, to send in an *actual order* to go ahead and do the work. The services of a *salesman* are necessary to induce him to sign the contract.

First of all, the prospect wants to know the cost of the wiring and fixtures, whether it will be necessary to have a switch in a certain room, whether it is advisable to have a center or a side outlet in another room? It is impossible to answer such questions in advertisements. It is necessary for the salesman to call on the prospect and after surveying the conditions, then he can answer these questions and quote prices. Therefore, if the advertising is successful in this campaign in bringing in the *inquiries* of interested prospects, it is all that should be expected of it. After an inquiry has been received it is a question of salesmanship to close the deal.

111m. Future Campaigns. The names of inquiries which are used in this campaign should be used again next year in another house-wiring campaign. Every home remains a prospect for wiring until a contract covering it is signed. The campaign which is waged next year will have the advantage of having been preceded by the form letters and publicity of the present campaign.

111n. Houses Wired, not Using Current. An investigation in Dawson reveals that there are now about 350 houses which are wired for electricity, but for which current is not purchased of the Dawson Light & Power Company. There are probably two reasons why these people are not using electricity: *first* they believe the cost of current is prohibitive or *secondly*, their houses are not equipped with electric fixtures. The answer to the first objection is the low wattage Mazda lamp—which practically lowers the rates for electricity. The answer to the second objection, is the offering of the sets of electric fixtures on a time-payment basis.

This class of prospects can be very easily secured as customers. They have already made the large initial investment of wiring; hence it is only necessary to show them the economy of electric service with Mazda lamps, or the low price of and the easy payments by which they can purchase electric fixtures.

FORM OF CAMPAIGN

112a. It is recommended that the basis of this campaign be a series of direct-by-mail letters to people living in their own homes in Dawson. Supplementing these there should be advertising in the newspapers, street cars, moving picture theatres and in the company's show window. Recommendations relative to these advertising media are given later in this report.

As previously stated it is believed advisable, for the present, to confine your efforts to securing orders for wiring houses which are occupied by their owners and located on your existing distributing lines. However general publicity in the newspapers, moving picture theatres, etc., will cover the entire field of landlords, tenants and home owners.

Date.

Prospect's Name and Address.

Dear Sir:– (or Madam)

Here is the greatest opportunity ever offered to the people of Dawson for equipping their homes with electric service.

Starting this week the cost of wiring has been greatly reduced. We have completed arrangements with local contractors whereby the work will be done at a very low figure.

More than this we will allow you twelve months to pay for the installation—in small monthly payments.

We will protect your interests in every manner possible by furnishing specifications under which the work will be done—specifications which assure you that your job will be executed in a thorough and workmanlike manner.

We will have the work installed complete, including wiring, fixtures and lamps, ready to turn on the current.

Think what this means in your home. You will have the cleanest, safest and best light known. There will be no damage to your woodwork or wall paper. And assuming that the complete installation costs you sixty dollars, you can pay for this in payments of only five dollars per month.

Won't you let us send our representative to give you an estimate of the cost of wiring your house? You are in no way obligating yourself by this request. We merely desire to acquaint you with the reasonable price of installing electric service in your home and of our easy terms of payment.

Please sign and mail us the enclosed card today.

Yours very truly,

DAWSON LIGHT AND POWER COMPANY

By.... .. . .

New Business Manager.

FIG. 23*C*.—Circular letter No. 1, to be multigraphed on central station letterheads.

The Dawson Light & Power Co.,
Dawson, Ohio.

Gentlemen:–

Please have your representative call and explain in detail your proposition for wiring our home for electric service. It is thoroughly understood that we do not obligate ourselves in any manner by this request.

Sign. . ...

Address . . . .

Time to call ... .

FIG. 23*D*.—Postal card to be submitted with letters Nos. 1, 2, 3 and 4. (Reverse side of this card to be printed with the name and address of the Dawson Light & Power Company.)

112b. Prospect List. It is recommended that the prospect list to be used in this campaign consist of 2000 names of people in Dawson, living in their own homes and located on the existing distributing lines of the Dawson Light & Power Company. Home owners constitute the best class of prospects for house-wiring and the fact of their being on the existing distributing lines eliminates the expense of making line extensions to serve them.

Date.... . . ..

Prospect's Name and Address.

Dear Sir:– (or Madam)

Electricity will give you the best light known—it is the clean light—the pure air light—the healthful light—the convenient light and the safe light.

Its advantages are so many that no architect would think of designing a modern home without this necessity.

Your home is not wired and probably you have thought that the cost, the litter and dirt incident to the work, would not repay you for the convenience of electricity in the home.

This is a mistaken idea which we wish to correct.

This work is quickly and neatly done—done in two or three days, without injury to your woodwork or wall paper.

And the expense is spread out over a period of twelve monthly payments —probably amounting to only three or four dollars a month.

We want an opportunity of presenting our proposition to you—it won't cost you a cent to hear what we have to offer—and if you will sign and mail us the enclosed card today we will have our representative call on you.

May we hear from you?

Yours very truly,

THE DAWSON LIGHT AND POWER COMPANY.

By....................................

New Business Manager.

FIG. 23*E*.—Circular letter No. 2, to be multigraphed on central station letterheads.

To obtain this list of 2000 names it is recommended that each of the five salesmen of the new business department be *required* to turn in daily on cards provided for this purpose the names of ten prospective customers. This will require only an hour each day for each salesman and is not likely to conflict with his regular work. On this basis it will require about a month and a half to obtain the prospect list.

Another plan, which might be used successfully in connection with the preparation of this prospect list is to hire school boys to furnish names for the list, paying them on the basis of the number of names they turn in. If this is done, care must be exercised to be certain that the names are those of people who own their homes and that they are located on the existing distributing lines of the Dawson Light & Power Company.

112c. Campaign. The direct-by-mail advertising campaign is to comprise the following:

Date ... .

Prospect's Name and Address.

Dear Sir: (or Madam)

Many of your neighbors have taken advantage of our offer to wire their homes for electric service—the modern light and the best light known.

Yet we have not been permitted to have our representative explain our proposition to you.

We feel confident that you want electric light in your home. And in view of the fact that the expense is really an investment, as in case of sale you can obtain more money for a wired house than for an unwired house, we feel that you should grant us this opportunity. The buyers of today are demanding that houses be wired for electric service.

We are offering to carry this investment for you—to string it out over a period of twelve months. In addition we are safe-guarding your interest by having the work done under strict specifications—something that has never been done in Dawson before.

In the home that is electrically equipped all of the electrical appliances may be used—the electric iron, vacuum cleaner, toasters, coffee percolators, etc.

The card, which we are enclosing, has the postage prepaid, and we hope that you will sign and mail it to us today without fail. You do not obligate yourself in any way by this request. It only means that our representative will call, and in a few minutes will give you an estimate of the cost of equipping your home for electric service.

Mail us the card today.

Yours very truly,

THE DAWSON LIGHT AND POWER COMPANY

By.. ....

New Business Manager.

FIG. 23*F*.—Circular letter No. 3, to be multigraphed on central station letterheads.

1st. Form letter, No. 1 (Fig. 23*C*) booklet "*Wiring a Home*" and return post card (Fig. 23*D*).

2nd. Form letter No. 2 (Fig. 23*E*), pamphlet "*Make the Old Home Bright*" and return post card (Fig. 23*D*).

3rd. Form letter No. 3 (Fig. 23*F*) and stamped return post card to be followed by:

4th. Call of central station salesmen on all inquirers.

5th. Call of salesmen on all names included in the prospect list, **regardless** of whether or not inquiry has been received.

6th. Mailing of letter, No. 4 (Fig. 23*G*) if so desired.

Date. . . . .

Prospect's Name and Address.

Dear Sir: (or Madam)

On (date. . . . .) our exceptional offer to wire your home at low cost and allow you twelve months to pay for the work will close.

After this date there will be absolutely no opportunity for you to take advantage of this liberal offer to install electric service.

Briefly, here is our proposition:

The work will be done at low cost—it will be done in two or three days after the signing of the contract—there will be no litter or annoyance to you—and when completed you have actually the best light known and can use any of the electrical appliances, such as a flat-iron, a washing machine or a vacuum cleaner.

More than this, we will string the payments out over a period of twelve months—small monthly payments of three or four dollars a month, depending upon the amount of your contract. We pay cash to the contractor doing the work and then allow you twelve months to return the money to us.

It is an exceptional opportunity. You know the advantages of electricity—its convenience, safety and cleanliness. And you know that it increases the value of your house in case of sale.

Over . . Dawson families have taken advantage of this offer and you are not as yet, among this number. Some of these people are probably neighbors of yours.

Our offer absolutely closes (date. . . . .).

It will not obligate you in any manner to find out how reasonable is the cost of wiring your home, and if you will sign and return the enclosed card we will be glad to have our representative call upon you. There is no obligation on your part, but you had better mail the card today in order to take advantage of our offer.

May we give you an estimate this week?

Yours very truly,

THE DAWSON LIGHT AND POWER COMPANY

By . . . .

New Business Manager.

(Enclose post card.)

FIG. 23*G*.—Circular letter No. 4, to be multigraphed on central station letterheads.

(The above letter may be sent out to the prospects, if so desired, after all inquiries have been taken care of. This letter tells the prospect that the liberal offer will close on a certain date, and that if he wishes to take advantage of your proposition he must do so at once. This letter is designed to bring in all inquiry cards of people who are interested and who have previously not replied to your letters.)

112d. Dates of Mailing. It is recommended that the campaign be inaugurated early in the Fall, preferably the first or middle of October, and that the letters follow one another at intervals of a week or ten days. The letters should be mailed the first of the week, preferably on Tuesday or Wednesday.

112e. Form of Letters. It is recommended that the letters be multigraphed on the stationery of the Dawson Light & Power Company. They should have the name and address of the prospect inserted by typewriter. The best results will probably be obtained, providing there are no multigraphing facilities in the office of the Dawson Company, if the entire job is delegated to a multigraphing firm in Dawson, where the work will be done under the direct supervision of the Dawson office. If this procedure is followed it will be only necessary to supply this firm with the stationery, the prospect list, the text for the letters and the postage. They will complete the job.

It is recommended that the letters used in this campaign be signed by some official of the Dawson central station, preferably Mr. Hearst, the New Business Manager. This signature can be reproduced by the multigraph. A plate can be made for this purpose. This will render it unnecessary to sign the letters by hand in ink.

Great care should be taken in the preparation of these letters to make certain that the name and address of each prospect is properly filled in, so that the letters will have the "personal" appearance, so desirable in direct-by-mail advertising. Wherever possible the letters should be addressed to the man of the house, rather than to the housewife.

112f. Subject Matter of Letters. The letters (Figs. 23*C* to 23*G*) used in this campaign should discuss principally the time-payment plan and the low price of wiring, supplemented by an outline of the general advantages of electric service in the home.

112g. Post Cards. The return post cards (Fig. 23*D*) enclosed with letters Nos. 1, 2 and 3 should be printed on stock of the same size as regular United States cards. The cards enclosed with letters Nos. 1 and 2 should be merely form cards with imprint "Place one cent stamp here." The card to be enclosed with letters Nos. 3 and 4 should have a one cent stamp affixed. It is deemed advisable to affix a one cent stamp to this last card, rather than use a standard United States post card, inasmuch as the stamp calls particular attention to the fact that the postage has been paid. As this is purely an inquiry-producing campaign everything should be so arranged that the prospect can with a minimum of effort send his inquiry to the station.

112h. Advertising Enclosures with Letters. The booklet "*Wiring a Home*" and the pamphlet "*Make the Old Home Bright,*" will be supplied gratis to the Dawson station, imprinted with its name, in such quantities as are desired. As soon as this campaign has been authorized, The National Lamp Works should be advised as to the exact imprint desired on this advertising matter as well as to the quantity that will be needed. At least 200 extra copies of each folder or pamphlet should be requested; these to be used for counter distribution from the display room. (This service is for National customers only.)

112i. Personal Follow-up by Salesmen. It is impossible to place too much stress upon the importance of the "follow-up" by the station salesmen after the inquiries have been received. Unless the inquiries are given immediate attention the results of the campaign will be materially affected. The advertising material is merely for the purpose of creating an interest on the part of the prospect. If properly followed up by the salesmen, this interest may be developed into an actual order for house-wiring.

As previously suggested in addition to the following up of each inquiry, it is recommended that every prospect included in the mailing list receive a call by a central station salesman. The salesman will find that the prospective customers can be readily approached because of the fact that his call has been preceded by a series of interest-arousing letters and that the prospect will be more or less familiar with the salesman's proposition. In following up the inquiries, no delay should be permitted between the time of the receipt of the inquiry and the time that the salesman calls. This call should be made while interest is aroused and should not be postponed for two or three weeks.

112j. Newspaper Advertising. It is recommended that one advertisement appear each day during the operation of this campaign in all newspapers having a circulation in Dawson. Mr. Hearst's suggestion relative to publishing in the daily papers from day to day lists of people who have had their homes wired is thoroughly endorsed. Photographs might be taken, of some of these wired houses, and reproduced in the newspapers. This is a splendid method of producing local interest.

It is understood that considerable advertising relative to the advantages of electric service in the home has appeared in the Dawson local papers prior to the inauguration of this campaign. It is therefore assumed that the people are entirely familiar with the convenience, cleanliness and safety of electricity for illuminating purposes. Hence it is suggested that the copy for this finished-building wiring campaign treat principally of the low cost of wiring, the specifications and the time-payment proposition. These characteristics will prove a new and interesting feature.

112k. Moving Picture Theatre Advertising. It is recommended that slides be placed with some of the prominent moving picture theatres of Dawson. This is a very valuable supplementary method of advertising and it is thoroughly endorsed for use in this campaign. As in the newspaper advertising, slides may be used showing houses in Dawson that have recently been wired for electric service. Another thing that should be emphasized in lantern-slide advertising is that people should send requests for estimates of the cost of wiring their homes. It should be brought out that they do not obligate themselves in any way by making such a request.

112l. Street Car Advertising. During the operation of this campaign it is recommended that street car cards be placed in all street cars in Dawson. It would probably tend to create interest if a new card appeared every few days giving the number of houses which had been wired to date under the new plan. The cost of printing these cards will be small. Black lettering on white stock will suffice. The reading matter on car cards should be very brief and to the point.

112m. Window Display Advertising. The excellent show window of the Dawson Station's office should be used to the best advantage during the campaign. As a suggestion for a window display: It might be of interest to introduce a guessing contest, the prize to be a vacuum cleaner, a washing machine or any of the other electrical appliances. The prize winner would be the person guessing nearest to the number of houses that will be wired during a certain period, the contest to be open until two weeks prior to the closing of the campaign. From day to day the number of houses wired could be indicated by a chart in the window representing a thermometer or a clock. Each day the chart should be set to indicate the number of contracts closed during the preceding day.

The contest should be confined to electric service customers. It should be so arranged that it will be necessary for each contestant to traverse the entire length of the display room to register his vote. This will necessitate his passing the many electrical consuming devices on display and will tend to familiarize him with the advantages of electric service. In a town the size of Dawson such a contest, if properly conducted, creates much local interest.

Placards outlining the low cost of wiring and the monthly payment plan should also be prominently displayed in the window. Other display cards should urge people to come inside and learn the details of the proposition.

CHAPTER VII

METHODS OF WIRING

GENERAL

113. Wiring for finished buildings can be classified into seven different methods as follows (the cost per outlet for each of these classes and the relative cost of each are given in the "*Cost*" chapter of this book): (1) Rigid Conduit, (2) Flexible Steel Conduit, (3) Flexible Steel Armored Conductor or Armored Cable, (4) Metal Molding, (5) Concealed Knob and Tube Work, (6) Wooden Molding, and (7) Open Wiring on Knobs and Cleats. Frequently two or more of these methods must be used in the same installation. Each of these methods, its adaptability and features involved in its installation, is discussed in paragraphs that follow.

113A. For more extended information regarding the different methods of wiring, details of the fittings used and pointers regarding manipulation, see the *American Electricians' Handbook.* It is not feasible to repeat here such data as affect the wiring of buildings under construction and that also affect the wiring of finished buildings. The wiring section of the handbook referred to above deals almost exclusively with the wiring of buildings under construction.

114. A cheap safe method of exposed wiring for finished buildings is yet to be developed in this country. All methods whereby the conductors are concealed are relatively expensive. There are a great many buildings—the smaller residences and stores—that offer, in the aggregate, a splendid load for the central stations. But there is no cheap exposed method approved by the Fire Underwriters in this country, that is safe and that also presents a good appearance, whereby these buildings can be wired. Exposed wiring on knobs and cleats is cheap and safe but is out of the running because of its unsightliness. Exposed conduit wiring is quite expensive and would not look well in a residence. Wooden molding wiring is cheap and can be made to look quite well for small residence work but its application is restricted and its use is not permitted in certain municipalities; furthermore, it cannot be classed with the safest methods. Metal molding can be made to present a good appearance even in residences, but it is too expensive. In Europe (see **172** and paragraphs that follow), several cheap, slightly and apparently safe methods of exposed wiring for finished buildings have been developed and are widely applied. Many European central stations, through these methods of wiring, appear to be getting about all the load obtainable. Doubtless, similar methods will, ultimately, be developed in North America.

RIGID CONDUIT WIRING

115. Rigid Conduit Installations in Finished Buildings. The installation of conductors in rigid conduit provides decidedly the most expensive but the most satisfactory and safest method yet developed. A good rigid conduit installation is impervious to water. It is very difficult, however, to wire an old building throughout with rigid conduit without a great deal of cutting and disfigurement of walls and ceilings. Hence it is seldom that a finished building is wired by this method unless it is undergoing reconstruction and plasterers and other building-trades mechanics are available to assist the wireman to cut his race ways and outlets and to repair the openings that it is usually necessary for him to make. If flexible steel conduit is used in certain locations in combination with rigid conduit an installation almost as good results. Furthermore the cost is decreased, and the building is not noticeably disfigured. For this reason, where metallic conduit is mandatory for concealed work, as it is in some municipalities, Chicago and Denver for instance, the finished-building wiring installations usually combine rigid and flexible steel conduit.

116. Properties and dimensions of rigid conduit and conduit fittings and data covering its installation in buildings under construction are given in full in the *American Electricians' Handbook.* The tables and other information involved is too extended for inclusion here.

117. In conduit installations conductors are usually "looped" from outlet to outlet and all outlet boxes must be available for inspection after the work has been completed. Splices can be made only in these available outlet boxes. The conductors should not be pulled in until the conduit installation is complete.

118. Where the conduit run is accessible, approved fittings can be used and it is not necessary to "loop" the conductors. Fig. 24 shows an example of such an installation. The attic is accessible, hence each of the fittings in it constitutes an accessible outlet box in which wires can be spliced and tapped. The vertical conduit run shown is carried up within the space in an outside wall and the horizontal run is clamped to the joists with pipe straps. Surface outlet boxes like that of *A* can be used where it is undesirable to cut a large hole in the ceiling, but the usual practice is to use pressed steel boxes with their lower edges set flush with the surface of the ceiling as at *B*.

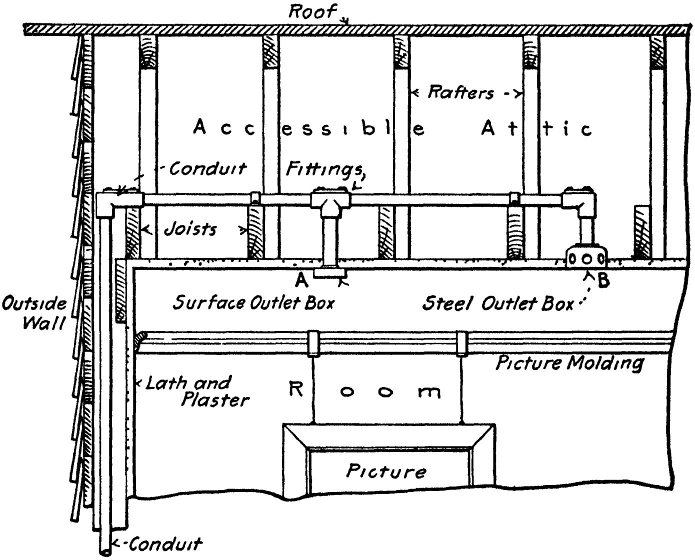


FIG. 24.—Installation of concealed conduit where the conduit run is available.

119. Slotting Joists for Conduit. Figs. 25 and 26 show how the floor joists of a frame building should be slotted for the reception of a conduit run. After the conduit is in place and held there with a few nails driven into the joists and bent over the conduit, the floor boards may be replaced. The slots should be as narrow and shallow as will comfortably admit the conduit. Those in the illustration are exaggerated in size so that they will show plainly. Each slot is fashiond by making two vertical saw-cuts in the joist and then gouging out the little block between the cuts with a wood chisel.

120. The general procedure in installing rigid conduit in finished buildings is about as follows: (1) Determine the location of the (*a*) entrance, (*b*) meter and (*c*) the panel box or distribution center; (2) install the feeder conduit to the panel box; (3) install the vertical runs within walls and partitions to bracket and switch outlets and the like; (4) connect the vertical runs with horizontal runs and (5) pull in the wire and connect it.

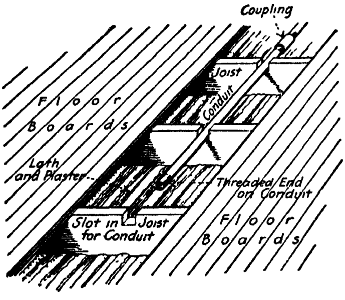


FIG. 25.—Method of slotting joist for the reception of conduit.

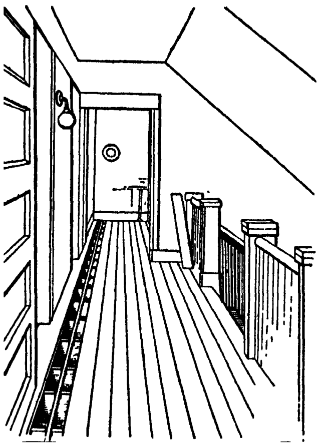


FIG. 26.—Second-story floor boards removed and conduit in place in slots in joists.

In certain cities, New York for example, the slotting of joists as shown in the above illustration, is prohibited by local ordinance. Where such restrictions exist it is necessary to bore a hole through the center of each joist and then use steel-armoured conductor or flexible-steel conduit.

121. The conduit for the feeder between the point of entrance and the panel box is usually installed on the cellar ceiling and is held thereto with pipe straps. The entrance switch and meter are most frequently located in the cellar. The panel box is usually in the first or second floor hall. A hole is bored from the cellar up through the floor plate or sill of the partition in which the panel box is to be located. An elbow is bent in one end of a length of conduit, of the diameter to be used for the feeder, and the conduit is pushed through the hole until one leg of the elbow rests against the cellar ceiling. It is cleated to the ceiling and the run is continued to the entrance. The panel box is later set down over the end of the piece that was pushed through the floor.

122. Installing the Panel Box in Rigid Conduit Work. A box, without its trim, in position with the conduit lines run into it, is shown in Fig. 27. The lath and plaster must be cut away as illustrated to provide for the admission of the box. At the sides the lath and plaster should be cut off flush with the faces of the studs. Vertically, the hole must be longer than the box to give a space in which the lock-nuts can be run on the conduit. The trim of the panel box (Fig. 84) should be made wide enough to cover the openings so left.

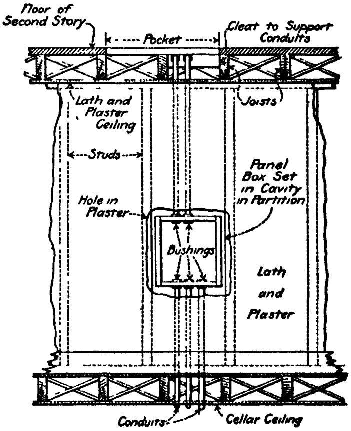


FIG. 27.—Panel box in a rigid conduit installation.

The box is made, as described in **193,** of such a width that it will just fit between the studs. Its overall depth should be about equal to the depth of the studs plus the thickness of the plaster so that the front edges of the box will lie flush with the surface of the plaster when the box is fastened in place. The plaster on the opposite side of the partition may extend through its lath a half inch or so. This should be considered in making the box.

Before the box is placed, the holes for the conduits that to are enter it should be bored through the ceiling and floor plates and through the bridges if there are any. The holes in the box for the conduits should be so spaced that the conduits will enter readily. The box being in position, the conduits are let down from above and pushed up from below and a lock-nut is run on each. Then they are pushed through the holes in the box and a bushing is turned on each one inside of the box. Frequently it is a good plan to place the conduits that are to enter the box from the bottom before the box itself is set in position. Then the box, the holes having been bored in its bottom, is set down over the conduits. Then the conduits that are to enter the box from above are placed.

123. Installation of a Rigid Conduit Switch Box. Fig. 28 shows such a box which serves, through *B*, an electrolier hung from the ceiling. It feeds, through *A*, from a conduit run located within the floor. This run comes from a panel box like that of Fig. 27. To place a rigid conduit switch box it is usually necessary to cut a hole, extending from stud to stud, in the lath and plaster of the partition; to remove the baseboard and to cut a pocket in the floor at the foot of the partition. If no conduit enters the switch box from below, the removal of the baseboard and the cutting of the pocket are unnecessary. It is almost impossible to fasten a switch box to rigid conduit with the necessary lock-nuts and bushings without cutting a reasonably large hole in the partition surface in which to work, even if a switch box of the compact type of Fig. 29 is employed.

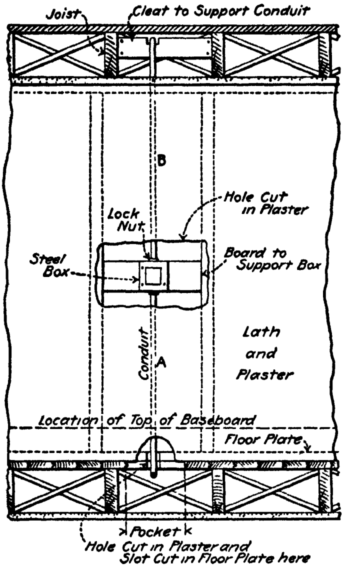


FIG. 28.—Rigid conduit switchbox in position.

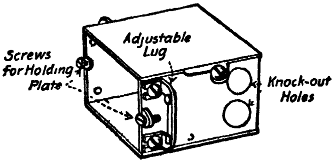
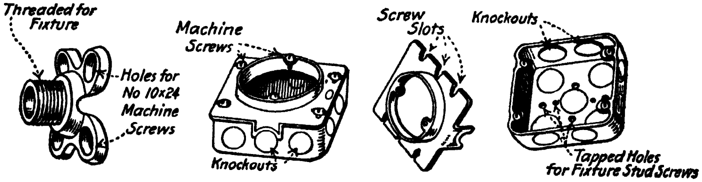


FIG. 29.—Steel outlet box for a switch or a plug receptacle.

A slot is cut in the floor plate—and in the floor if it extends under the floor plate—it being assumed that the baseboard has been removed. A conduit elbow is placed in the slot with one arm "looking" toward the switch box and the other extending out parallel to the joists. Then a length of conduit, just long enough to reach the switch box, is screwed to the arm of the elbow within the partition. The switch box is clamped to it with lock-nut and bushing and is then fastened with wood screws to the board that has been nailed in between the studs for its reception. The board should be located far enough back from the face of the partition that when the box is set its outer edge will be flush with the partition surface. The conduit run upward from the switch box can then be continued by dropping a conduit length down to the box from above and fastening it thereto with a lock-nut and a bushing.


Threaded for Fixture
Holes for No 10×24 Machine Screws
Machine Screws
Knockouts
Screw Slots
Knockouts
Tapped Holes for Fixture Stud Screws

A. Fixture Stud. B. Assembled. C. Cover. D. Box.

FIG. 30.—Bracket-box and fixture stud.

Fig. 30 shows the type of steel outlet box that is used; however, a "switch outlet" cover is employed instead of the round cover shown which is designed for bracket or electrolier outlets.

124. Installation of a Bracket Outlet Box. The bracket box (Fig. 31) is set in essentially the same manner as the switch box. However, the opening in the cover is round instead of rectangular. Fig. 30 shows the box assembled and disassembled. The fixture stud, held to the back of the box with four No. 10 × 24 machine screws, is for supporting the fixture.

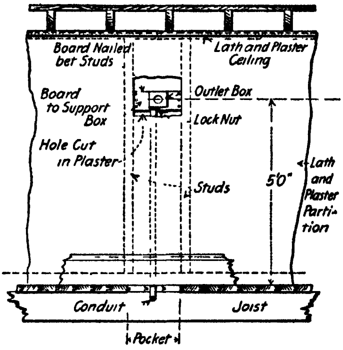


FIG. 31.—Conduit run to a bracket outlet in a finished building.

125. The method of joining rigid vertical conduits by a horizontal connection within a floor is illustrated by Fig. 32. It is desired to connect *B*, which is from a switch outlet, to *A* which is from a bracket outlet. Both terminate just below the floor. Remove the floor boards and slot the joists as shown. Measure the distance from *B* to *C* where the connecting conduit must turn toward *A*. Bend a piece of conduit of the required length to an L shape so that it will just fit in between conduit ends *A* and *B*. At each end of the connecting conduit cut a running thread, Fig. 33. Hold the connecting conduit thus prepared with its ends butted against conduits *A* and *B* while the couplings are screwed on the ends of these two pieces of duct.

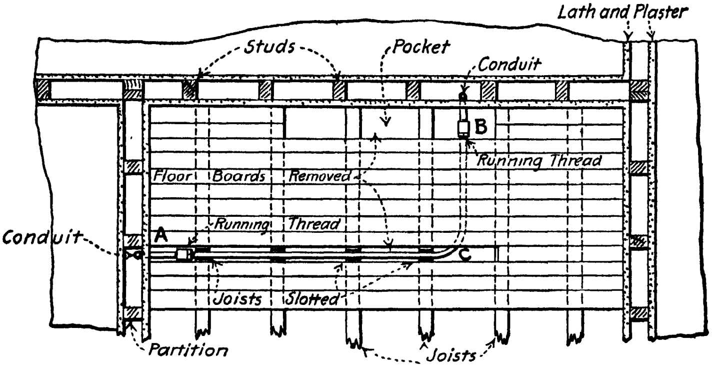
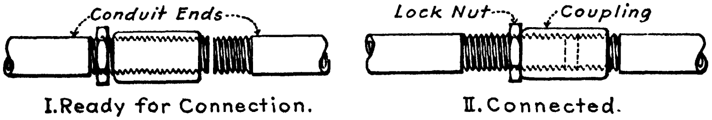


FIG. 32.—Method of installing rigid conduit within a floor.

126. Supporting Electroliers Fed from an Attic. In halls or high-ceilinged rooms where the use of staging built up from the floor is expensive or otherwise undesirable, fixtures may be supported as shown in Fig. 34. First determine the location of the ceiling outlets by careful measurements and cut a 1-in. hole in the ceiling at each such outlet.



I. Ready for Connection. II. Connected.

FIG. 33.—Running thread.

Directly over the outlet nail a piece of 2 × 4 timber between the joists and through it bore a 1-in. hole in the same vertical line with the hole in the ceiling. Then fasten a 4-in.

outlet box on the timber with wood screws. Into the outlet box run the conduit, which can be carried in a groove in the tops of the joists.

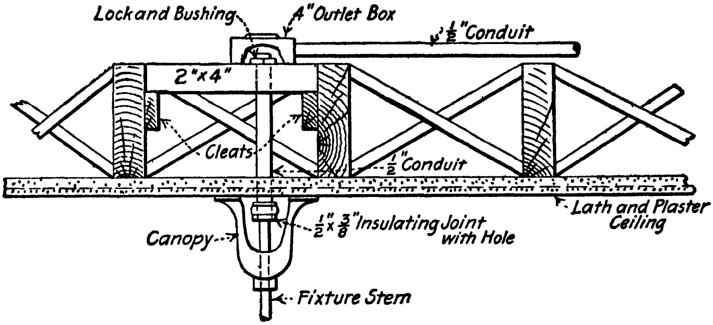


FIG. 34.—Supporting fixture from an attic.

A piece of half-inch conduit is then cut the proper length to reach from the outlet box to the ceiling. Both ends of this pipe having been threaded, it is screwed to the fixture by means of a 1/2-in. X 3/8-in. insulating joint used for combination fixtures. Then assemble the fixture completely on the floor, running the fixture wires up through the insulating joint and the piece of conduit. Pull the fixture up. A 1/2-in. lock-nut and bushing screwed onto the pipe will complete the job and hold the fixture in place.

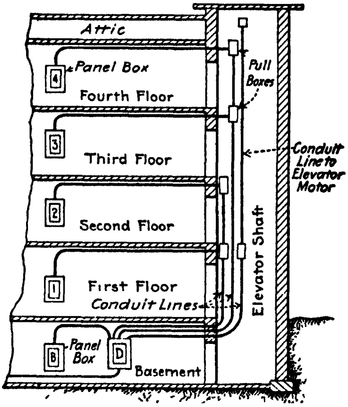


FIG. 35.—Conduit lines installed in an elevator shaft in a finished building.

127. Installing Conduit Lines in Finished-building Elevator Shafts. In a building having an elevator shaft and no other vertical way in which the conductors can be carried, they can often be installed, provided they are in conduit, in the elevator shaft as shown in Fig. 35. Conduit wiring is the only method that is approved by the *Code* for elevator shafts. A good conductor layout is shown. A panel box having a branch-circuit capacity sufficient for that floor is located on each floor and an individual main is carried from a distribution cabinet in the basement to each of the boxes. A separate conduit line is carried to the elevator motor.

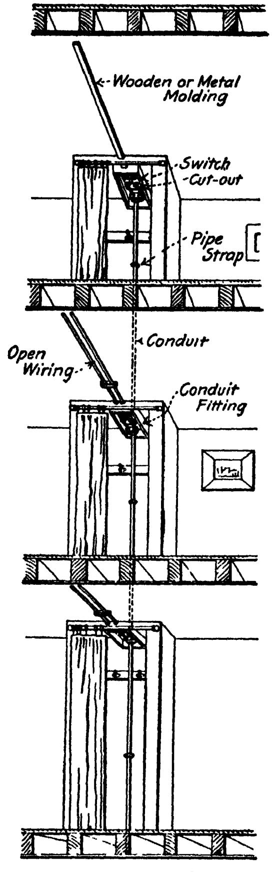


FIG. 36.—Vertical conduit run to serve different floors or different apartments.

128. In a building of several stories a conduit riser can often be employed advantageously as suggested in Fig. 36. The illustration shows the wiring of an apartment building wherein the service to the apartment on each floor is tapped from the vertical riser, which is carried in conduit through a tier of closets. The closets being located on each floor, one directly over the other, provide for the concealment of the conduit run and for its relatively easy installation. Sometimes it is preferable to install the vertical conduit riser on the exterior of an old apartment building rather than on the interior. Usually a central station will place a riser to feed several apartments at its own expense, so the owner merely has to pay for the wiring in the apartments themselves.

129. Exposed conduit for finished-building wiring is sometimes employed as suggested in Fig. 37. Such an installation is relatively expensive but is sometimes necessary where concealed work is not feasible, where molding work will not be accepted and where open wiring on knobs and cleats cannot be put in, either because of its unsightliness or because it may be interfered with.

130. Rigid Conduit Installed on Building Exteriors. This method (Fig. 38) of wiring is sometimes utilized where it is desirable to make a conduit installation at minimum cost or where because of double floors or obstructions within walls or partitions it is impossible to route the conductors in any other manner.

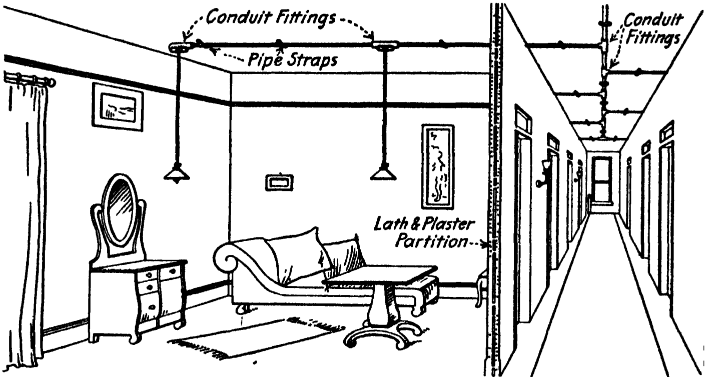


FIG. 37.—An exposed conduit installation.

Probably piping installations, made in finished buildings for illuminating gas, suggested this device for handling conductors because one notices, particularly in the older towns of the middle west, many old buildings served with gas with the principal runs of piping secured to the outside of the house with pipe straps. Where zinc-coated conduit that will "take" paint effectively is used, and where the exposed exterior conduit runs are carefully concealed in corners and behind downspouts, the conduit, when painted the same color as the surface that supports it, will be inconspicuous. The method can be used very effectively in many cases where the cost of wiring by any other would be prohibitive. See **299** for the description of a building wired by this method.

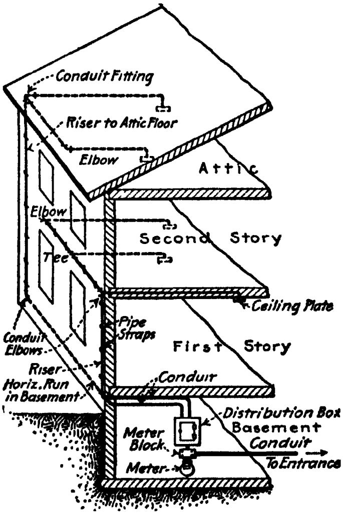
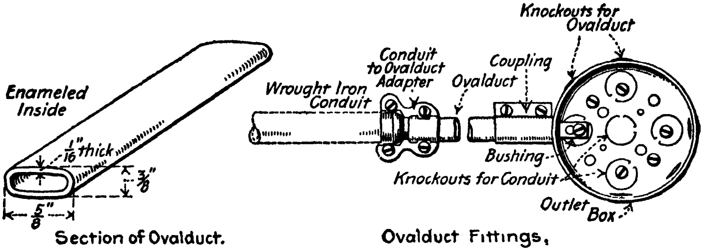


FIG. 38.—Supporting conduit on building exterior.

131. Ovalduct (Fig. 39), made by the National Metal Molding Company of Pittsburgh, is seamless drawn-steel tube, sherardized inside and out and then enameled on the interior. It can be readily bent flat side or end wise to conform to the surface on which it is to be mounted. The dimensions are given in the figure. It is used principally in making additions to existing conduit wiring in fireproof buildings. Where extensions are made with conduit in these buildings, it is frequently necessary to channel deep race ways for the reception of the conduit. Floor arches may be destroyed and their strength seriously impaired. With the ovalduct extensive channeling is unnecessary. It can be laid in a shallow groove in the plaster and fastened to the fireproofing in the ceilings with short tie wires which are fished through two small holes in the tile. After installation it is plastered over so as to be entirely concealed. Ovalduct will accommodate two double-braid No. 14 wires or one No. 14 duplex wire. Two No. 14 wires pull in more readily than does one duplex. Outlet boxes and other fittings are manufactured for ovalduct. Adapters, whereby it can be joined to wrought-iron conduit runs, are obtainable. Fig. 40 shows an application wherein oval-duct, laid in a plaster ceiling, joins a wrought-iron conduit run.



Section of Ovalduct. Ovalduct Fittings,

FIG. 39.—Ovalduct and fittings.

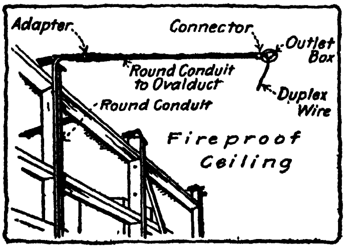


FIG. 40.—Ovalduct joined to conduit on a fire proof ceiling.

FLEXIBLE METALLIC CONDUIT AND FLEXIBLE STEEL ARMORED CABLE WIRING

132. Flexible metallic conduit wiring for finished buildings (Fig. 41) is widely applied where high-grade work is desired and in cities where the use of metal conduit for concealed work is mandatory. It can be used in practically all locations and is frequently preferable to rigid conduit because it can be installed at less cost and in less time. It is made in lengths of from about 100 ft. for the 1/2-in. diameter size to 50 ft. for the 2-in. size, which promotes rapidity and ease of installation. Practically the same *Code* rules apply to flexible as to rigid conduit. Double-braid, rubber-insulated wires must be used. Steel outlet boxes must be installed at all outlets and switches. The conduit must be continuous from outlet to outlet, must be fastened in outlet boxes with lock-nuts and bushings and it must be grounded.

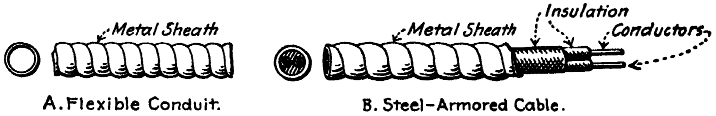


FIG. 41.—Flexible metallic and flexible steel armored cable.

Due to its flexibility and the fact that it can be procured in long lengths its application is feasible and desirable where rigid conduit could not be considered. It is particularly adaptable for finished-building wiring. No elbow fittings are required but the duct must be securely fastened where bent to form an elbow. Many fittings are manufactured especially for it. See the *American Electricians' Handbook* for further information.

133. Flexible steel armored conductor or flexible steel cable for finished-building wiring (Fig. 41, the two terms are different names for the same product) is used in about the same way and for essentially the same purposes as is flexible metallic conduit. However, the armored conductor is more expensive per foot than the equivalent conduit into which ordinary rubber-insulated wires have been drawn. Therefore, the conduit is used instead of the armored conductor where feasible. For difficult runs it is more satisfactory to fish the armored conductor through once for all than it is to fish the flexible conduit and then pull the conductors into it.

134. Construction, Application and Grades of Flexible Metallic Conduit and Flexible Steel Armored Conductor (Fig. 41). The conduit is made by rolling spirally together strips of zinc-coated sheet steel. The edges of the strips are joined so that a flexible tube is formed. The armored conductor or cable is the conduit plus insulated conductors. The metal strips are spirally formed around the insulated conductor. Flexible cable is graded as BX and as BXL. The BXL has a lead sheath under the steel one, to protect the conductors from moisture, which fits it for use in damp places. BXL can be plastered into brick walls. For use on the surface of masonry walls, unless they will always give out moisture, BX (which is the same as the BXL except that it has no lead sheath) is usually approved.

135. Splicing flexible conduit is effected as illustrated in Fig. 42. Short lengths are not thrown away but are joined with the special

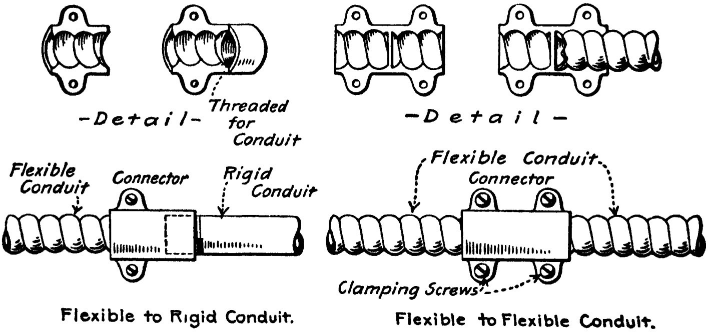


FIG. 42.—Connectors for flexible conduit.

fitting as shown. Rigid conduit can, likewise, be joined to flexible conduit. The use of these connectors is not held to conflict with the *Code* rule that requires that the flexible conduit must be continuous from outlet to outlet. The function of the connector for flexible conduit is the same as that of a coupling for rigid conduit.

136. Installation of a Wall Bracket Box for Steel Armored Cable or Flexible Conduit. See Fig. 43. The exact location of the outlet having been determined and the wireman having assured himself that he can get his conduit to the outlet, the hole is made in the plaster for the box. Place the box (Fig. 44) on the partition in the position it is to occupy and draw a line around it with a pencil. Cut around this line with a sharp chisel down to the plaster and remove it. Cut away the section of lath extending across the center of the hole. Drop a mouse down from the hole into the partition and pull the end of the conduit up and out of the hole. Clamp a 90-degree angle connector (Fig. 45) on the end of the conduit and fasten it into the box with a lock-nut as shown in Fig. 43. Insert two 7/8-in. cleats, one for above and one for below, through the hole and fasten them in place inside the partition as shown, each with a couple of small-diameter wood screws turned in from the outside. Push the box

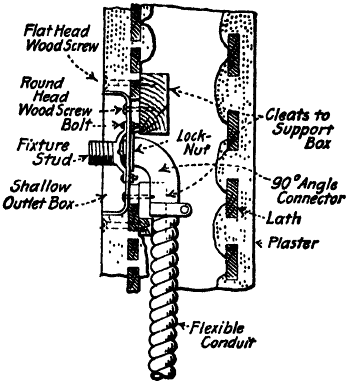


FIG. 43.—Section of a partition showing flexible conduit bracket outlet box in position.

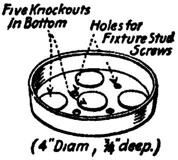


FIG. 44.—Standard ceiling box.

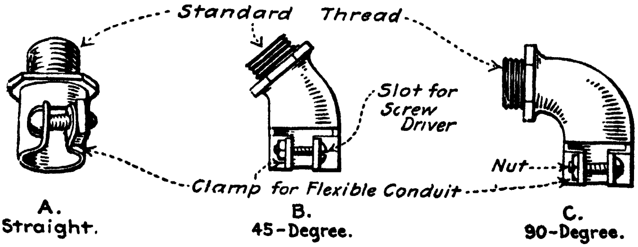


FIG. 45.—Angle connectors for flexible conduit and steel armored cable.

back in the cavity cut for it and fasten it to the cleats with wood screws. Fasten the fixture stud in position.

137. Installation of a Switch Box for Flexible Conduit or Steel Armored Cable. The procedure is almost identical with that, illustrated in Fig. 43 and described in **136,** of installing a bracket box A steel box which may be used for either a switch box or a plug receptacle case is shown in Fig. 29. When used for a switch, the box is set in the recess in the partition so that the adjustable lugs rest on the lath to which the box is to be fastened and the outer edge of the box lies almost flush with the plaster surface. No. 6 flat-head, wood screws are used for holding the box. When the box is utilized for a baseboard plug receptacle the adjustable lugs are reversed so that the face of the box will lie flush with the face of the baseboard. In attaching flexible conduit to the box, straight or angle connections (Fig. 45) can be used. There should never be more than two 90-degree elbows in a conduit run. Where there are more than two it is very difficult to draw the conductors through.

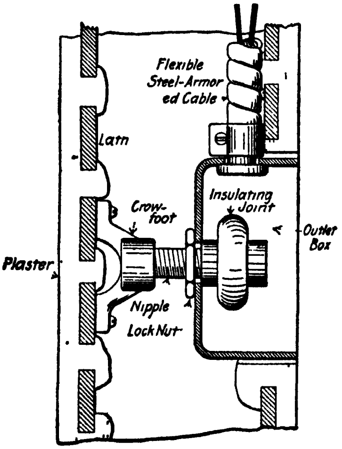


FIG. 46 —Method of mounting box for bracket fixture.

138. Attaching a Flexible Steel Conduit or an Armored Cable Bracket Outlet Box in a Partition by Means of a Fixture Crowfoot (Fig. 46). A hole should be carefully cut in the lath and plaster just large enough to admit the box. A crowfoot should be fixed to the lath of the opposite side of the partition with wood screws. A nipple sufficiently long to extend about 1/4 in. into the bottom of the box should be screwed into the crowfoot. Turn a lock-nut onto the nipple. With its connector attach the conduit to the box. Place the box, with its center outlet hole over the nipple, into the cavity prepared for its reception. If the hole for the box through the plaster has been accurately cut so that the box cannot wobble in it, the method provides a very firm support. In the illustration, a space is shown between the sides of the box and the plaster—actually the box should just fit the hole in the plaster. This method can also be used for supporting ceiling outlet boxes and electroliers, Par. **141.**

139. Installing an Outlet Box for Flexible Metallic Conduit in a Furred Ceiling (Fig. 47). Cut the hole for the box at the correct location through the lath and plaster. Fish the conduit to the outlet and attach the connector. Insert a cleat, sufficiently long to bridge two furring strips, through the outlet hole and secure it directly over the hole with long, small-diameter wood screws. Attach the box to the connector and fasten the box to the cleat with wood screws. The cleat transfers any weight imposed on the box to the furring strips which will safely sustain any weight ordinarily encountered. If the screw heads are conspicuous they can be painted the color of the ceiling.

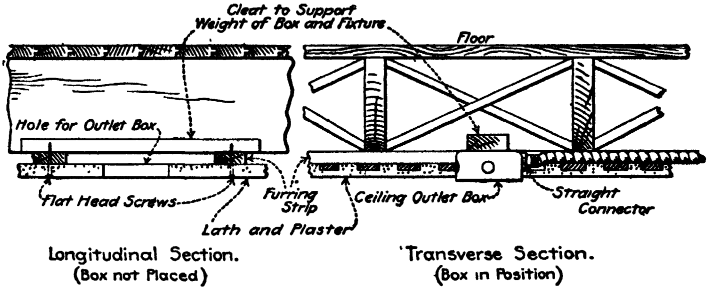


FIG. 47.—Supporting outlet box on a furred ceiling.

140. Placing the outlet boxes should be the last step in a flexible conduit job. The boxes should not be removed after they have once been set in a wall or partition. Their removal usually disfigures the wall paper and decorations. It sometimes is necessary, prior to the completion of a job, to connect a stray conduit into scme box because of an obstacle preventing the installation of the conduit as originally planned. Obviously, the conduits should, where possible, be installed complete before the outlet boxes are installed.

141. Attaching a Metallic Flexible Conduit Outlet Box in a Metal Ceiling. See Fig. 48. Cut a round hole in the ceiling just large enough to admit the outlet box. Fish the conduits to the hole and attach a 90-degree connector (Fig. 45) to each. Drill a hole, large enough to accommodate a good-sized wood screw, in the center of a pipe cap and secure the cap as illustrated to the floor above, directly over the center of the hole for the outlet box. Turn into the inverted pipe cap a conduit nipple of such a length that when the outlet box is fastened on its end the face of the box will lie flush with the ceiling surface. Run a lock-nut on the nipple. Put the box on the nipple, first having connected the conduits into the box. Run another lock-nut on the nipple to hold the box in place. If more convenient, the nipple, pipe cap and outlet box can be made up as one piece and the screw can be inserted through the nipple with a long-blade screw driver. A modification of the method of Fig. 46 for supporting a bracket can also be used. These methods should not be used where the fixture will be heavy.

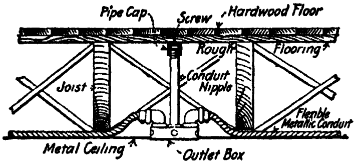


FIG. 48.—Outlet box attached in ceiling.

142. Flexible metallic conduit must not be used where it is subjected to moisture. Sometimes inspectors will object to its installation under floors where scrubbing water might drip through. It should not be run vertically through floors where scrubbing water may affect it. If lead-covered conductors are drawn into flexible conduit so installed, the work will be in accordance with the *Code*, but the usual practice is to install a length of rigid conduit where an exposed run passes through a floor, Fig. 49.

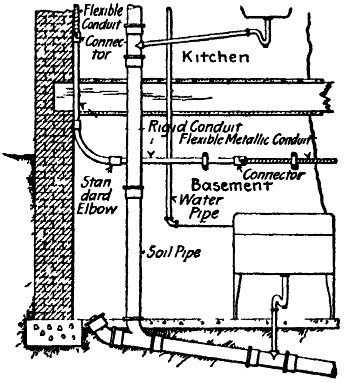


FIG. 49.—Rigid conduit inserted where conduit is exposed to moisture.

143. A device for pulling in flexible conduit is shown in Fig. 50. It comprises a length of sash cord, a piece of wire, a couple of feet long, and a flexible conduit plug or drag which is furnished by the manufacturer of the conduit. The wire is made up about the cord as described for the conduit pulling-in line of Fig. 140. In use the plug is screwed into the conduit; the pulling-in line is drawn through the wire way and pulls the conduit after it.

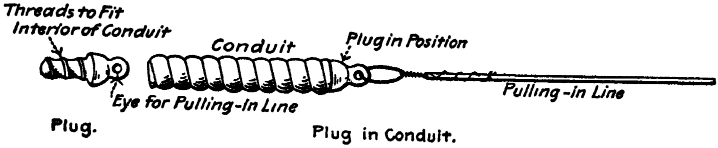


FIG. 50.—Arrangement for pulling in flexible conduit.

143a. Running Flexible Metallic Conduit or Armored Cable in Furred Walls. Where brick walls are furred the furring on the front and rear wall usually varies in thickness from 2 in. to 7/8 in. The furring on the side walls is usually 7/8 in. thick. The outside diameter of No. 14, duplex flexible armored cable is approximately 7/16 in., hence it is readily accommodated in the space provided by furring strips.

COMBINATION OF RIGID AND FLEXIBLE CONDUIT

144. Rigid Conduit in Combination with Flexible Metallic Conduit. As hereinbefore outlined, it is seldom that rigid conduit can be used throughout for an entire finished-building job. It is usually necessary to combine flexible metallic conduit with it for certain portions of the work. It is also true that it is seldom desirable to use flexible metallic conduit exclusively. There are usually parts of the installation for which rigid conduit can be applied so as to save both time and cost. Where the conduit run is reasonably straight and available for manipulation, rigid conduit can usually be applied to advantage. For concealed runs and where fishing is necessary the flexible conduit is usually the most satisfactory.

144a. The Procedure in Wiring a Building with Flexible Conduit or Flexible Armored Cable. Usually the first operation is to locate all of the outlets, a consultation with the owner being required to effect this. Some wiremen then cut the openings for the ceiling, bracket and switch outlets. Other men, as suggested elsewhere herein, prefer to wait, if possible, until the wireways are completed before any walls or ceilings are cut. Where there is no opening into the attic the wireman cuts one in the ceiling of a clothes closet. A trap door should be furnished for and fitted to this opening. The necessary floor pockets are cut and the conduit or cable is fished into the floor and partition spaces. Standard metal boxes are installed at each outlet, being affixed to the lath or to studs as herein elsewhere described. For straight electroliers substantial supports must be provided. At combination gas and electric outlets the gas pipe serves as a support.

145. Flexible Metallic Conduit used Instead of Bending Rigid Conduit. Fig. 51 shows an application of this. It would be quite difficult to bend a double elbow to fit in the space indicated and to connect it into the conduit line. With the flexible metallic conduit the problem is easily solved.

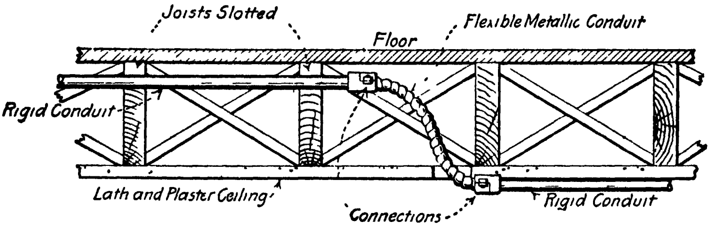


FIG. 51.—Using flexible metallic conduit instead of a double elbow to connect two lengths of rigid conduit.

146. Combination of Rigid and Flexible Conduit where Run is Exposed to Moisture. As hereinbefore noted, flexible metallic conduit is not approved by the *Code* where exposed to moisture. Where wet, damp or moist zones are encountered along the route of the run, rigid conduit should be inserted as indicated in Fig. 49. Some of the common locations in which rigid is commonly substituted for flexible conduit are: laundries, lavatories, pump rooms, around water tanks, and bath rooms. Many inspectors consider all cellars as "damp" and insist on the installation of rigid conduit for all runs therein.

147. The substitution of one rigid conduit for several flexible conduits can frequently be made to effect a saving in time and material. Fig. 52 illustrates the method. The conduit line shown in Fig. 26, which runs the entire length of the second floor, carries several circuits. The *Code* permits (Rule 26-*p*) the same conduit to contain 4 two-wire or 3 three-wire circuits of the same system without special permission. Frequently, special permission can be secured whereby more than the above specified number of circuits can be carried in the same conduit. Junction boxes, as shown in the illustration, must be inserted at all points where conduit runs branch off or where there are to be splices in the conductors.

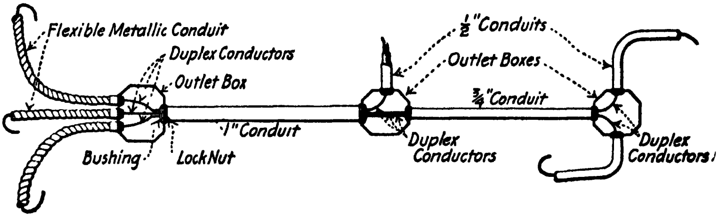


FIG. 52.—Rigid and flexible conduit in combination.

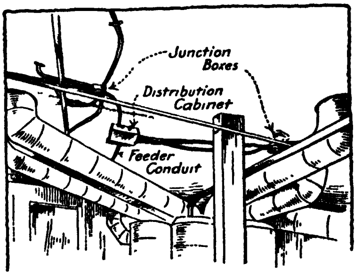


FIG. 52*A*.—Distribution cabinet and two junction boxes on a cellar ceiling.

147a. A distribution cabinet and junction boxes in a combination rigid-and-flexible conduit installation are shown in Fig. 52*A*. Usually such cabinets are fastened to side walls, but in the instance illustrated the ceiling was sufficiently low that it could be reached by a man standing on the floor. Hence it was used instead of a side wall. The service switch cabinet and the meter are in a room to the rear of that shown. From these the feeder conduit was carried along the ceiling, cleated thereto with pipe straps, to the distribution cabinet. From the cabinet two conduits run, each to a junction box supported on the ceiling. From the junction boxes the armored cables or flexible conduits run to the various outlets on the floors above.

148. Conductors imbedded within brick or masonry walls must be encased in flexible or rigid conduit. If the wall is or may be damp either rigid conduit or leaded, steel armored cable must be used. Fig. 53 illustrates how the wall may be channeled and the conductors supported. For supporting the conduit, pipe straps are sometimes used, but the method illustrated is preferable inasmuch as the materials required are always at hand. As shown in section *A* of the figure, after the conduit is in place in the groove cut in the brick, two nails are driven part way in, on opposite sides of the conduit. The ends of a piece of wire, preferably No. 12 galvanized iron, are twisted around the nail under the heads, the wire bridging the conduit. The nails are then driven home and the wire will grip the conduit tightly as shown at *B*, holding it firmly in place. Such supports should be located about every 2 ft. along a length of flexible conduit. After the conduit and outlet boxes are in position in a wall the spaces around them should be filled up, flush with the wall surface, with plaster of Paris.

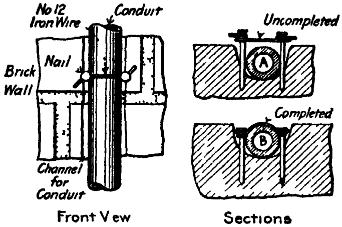


FIG 53 —Method of holding conduit in brick wall

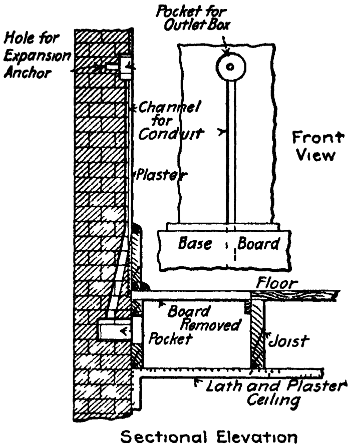


FIG 54 —Method of cutting brick wall for conduit

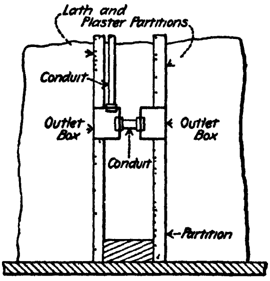


FIG. 55—One vertical conduit serving two outlets.

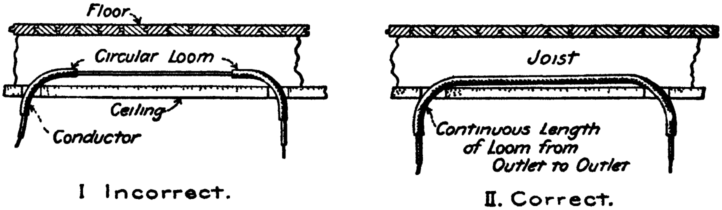
Fig. 54 shows the groove cut in the wall for the reception of the conduit.

149. One vertical conduit run can often be made to serve two outlets as shown in Fig. 55. If it is possible to cut the holes for the outlet boxes directly opposite each other from opposite faces of the partition a short conduit nipple can be employed to connect the two and one riser will serve both.

KNOB AND TUBE WIRING

150. Knob and tube wiring for finished buildings is the cheapest method of installing concealed conductors and is probably more widely used than any of the systems for old-structure work. Its use is prohibited in certain cities where conduit wiring only is permitted for concealed work. When carefully installed, knob and tube wiring is safe. The *National Electrical Code* permits its use and gives specifications as to how it should be installed. The wires are concealed within walls, floors and partitions. On joists and studs the wires are supported on porcelain insulators (knobs). Where they pass through joists the holes are bushed with porcelain tubes. The *American Electricians' Handbook* covers thoroughly the subject of knob and tube wiring in buildings under construction and the reader is referred to it for the information that applies to both old and new building work.

151. The Use of Flexible Tubing or Circular Loom in Finished-building Wiring. It must be continuous from outlet to outlet on conductors that are fished within walls, partitions or floors where the conductors cannot be supported on porcelain as specified by the *Code*. For example, in II of Fig. 56 is shown the method of

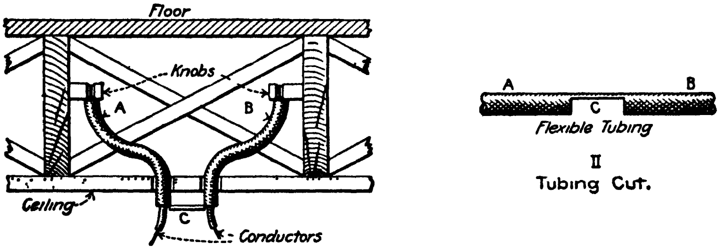


I Incorrect. II. Correct.

FIG. 56.—Methods of encasing conductors with loom.

complying with the rule, while I illustrates its infringement—due usually to ignorance rather than bad intent on the part of the wireman. Beginners at finished-house wiring sometimes place lengths of tubing on the conductor only at points where it passes through outlets, as shown at I. The external appearance of the two methods is similar. But the wiring inspector readily can determine whether the tubing covering is make-shift or complete by grasping the tubing in one hand and the conductor in the other and moving the wire within the tubing. If the tubing is continuous from outlet to outlet the wire cannot be shifted, whereas if short lengths are used only at outlets the wire will move easily within the tubing.

152. A method of placing tubing at outlets so that it cannot work through the plaster is illustrated in Fig. 57. Before the tubing is slipped over the wire a piece is cut from the center of the tubing as indicated at *C* in the figure, providing a length on either side of the slot sufficient for one wire. The tubing is then slipped over the conductors. The piece *C* prevents the tubing from working into the space between the floors.



I. Tubing in Place.

II Tubing Cut.

FIG. 57.—Tubing cut for an outlet.

153. Wiring a Bracket to Meet Code Requirements. In order to meet the Underwriters requirements where flexible tubing-covered conductor is being installed, it is often necessary to wire for a bracket outlet as shown in Fig. 58. A tap must be brought down from the support in the ceiling space above to the outlet, even though a conductor (which ordinarily might be utilized) drops through the partition to the floor below. No taps should be made within the partition except at a point of support—an insulator. This important feature of finished-building wiring frequently is overlooked until the wiring inspector's investigation and just as frequently results in an order to rearrange the conductors to conform with the wiring regulations.

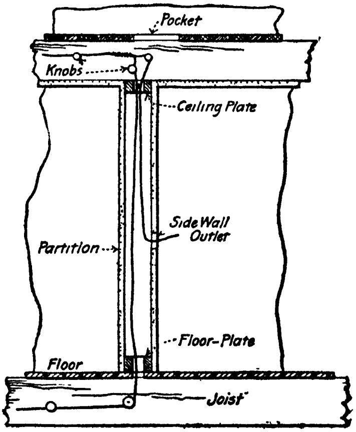


Fig. 58.—Conductor arrangement to satisfy underwriters' requirements.

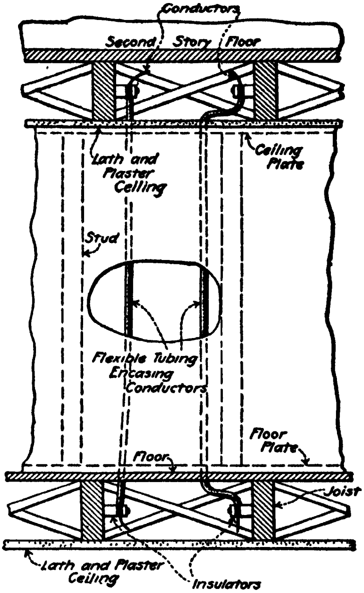


Fig. 59.—Knob and tube method of wiring in a partition.

154. Knob and Tube Method of Carrying Conductors from Floor to Floor within a Partition. See Fig. 59. A point of support—a knob or insulator—is arranged at the head and at the foot of the partition. The raceway through the partition can be prepared either with the pipe-extension boring tool of **230** or by one of the other methods described herein. The flexible tubing which encases the conductors must be continuous from insulator to insulator.

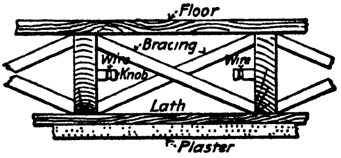


Fig. 60.—Method of running wires past bracing.

155. In running wires past bridging between joists, the method indicated in Fig. 60 should be followed. The wires are carried along on knobs which should be secured on the joists at intervals of 4 1/2 ft., unless the wires are encased in flexible tubing in which case intermediate supports are not required. When the wires are not encased and are run parallel to joists it is necessary to remove a floor board at least every 4 1/2 ft. in order to provide a pocket in which the knobs can be secured to the sides of the joists. When this method is not followed there is danger that the wires will get under or above the braces instead of between them and when drawn taut they will interfere. If it is not possible to arrange supports every 4 1/2 ft. the conductors must be encased in flexible tubing—continuous from point of support to point of support.

156. The knob and tube method of wiring finished-building ceiling outlets is illustrated in Fig. 61. Flexible tubing is pushed over the conductors so as to extend from the last points of support—the insulators—to an inch or so beyond the ceiling surface. If the fixture is not heavy, a crowfoot (see Fig. 46), held to the laths with screws, will carry it but if it is heavy a ceiling-block should be fastened to the laths in the ceiling with long wood screws. The crowfoot can then be fastened to this block.

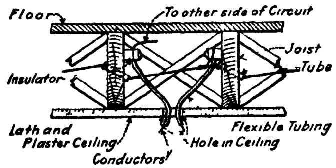


FIG. 61.—Knob and tube method of ceiling outlet installation.

157. Another method of installing an electrolier with circular loom wiring is illustrated in Fig. 62. Cleats can be introduced through the outlet hole and fastened to the ceiling with long, flathead wood screws. The crowfoot supporting the electrolier is fastened to the ceiling with long flathead wood screws, which

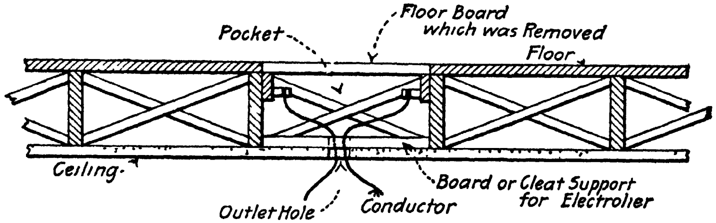

Floor Board which was Removed
Pocket
Floor
Ceiling
Board or Cleat Support for Electrolier
Outlet Hole
Conductor

FIG. 62.—Mounting board for electrolier.

should pass entirely through the plaster and into the cleat. Crowfeet have a tendency to dig into the plaster when they are clamped to a ceiling with screws. One way to prevent this is to use a sheet-metal disc having holes drilled in it for the circular loom and for the screws. The disc should be of such a diameter that it will readily fit within the electrolier canopy. By preventing a crowfoot from loosening the plaster the disc will cause an electrolier to hang plumb.

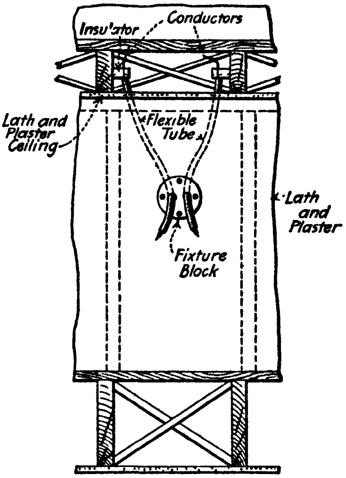
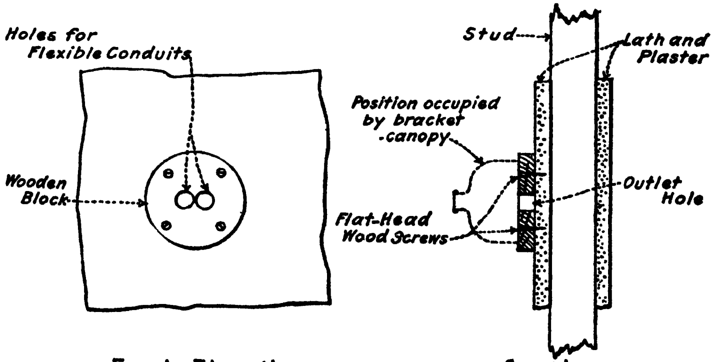


Fig. 63.—Knob and tube wiring for a bracket.

158. The knob and tube method of wiring a bracket is pictured in Fig. 63. Wires run within the space between floor and ceiling are fastened on porcelain knobs screwed into the joists. After being encased with flexible tubing the conductors are dropped down within the wall space to the bracket outlet. The tubing should be long enough to extend from the porcelain knobs to 3 in. beyond the plaster at the outlet. Holes are bored in the fixture block to permit the



Front Elevation. Section.

Fig. 64.—Mounting block for bracket in position.

tubing to pass through. If the round fixture block does not provide sufficient support, cleats, previously inserted through the outlet hole, can be arranged inside the partition as described for the ceiling outlet in **157.** Fig. 64 shows the mounting blocks for the bracket in position.

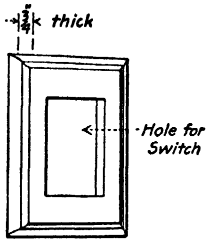


FIG. 65.—Wood block for mounting flush switch.

159. Wooden Base Blocks for Fixtures and Switches. The *Code* specifies thus: "Where possible, at all switch or fixture outlets, unless outlet boxes which will give proper support for fixtures are used, a 7/8-in. block must be fastened between studs of floor timbers, flush with the back of the lathing to hold tubing and to support switches or fixtures. When this cannot be done, wooden base blocks (Fig. 65), not less than 3/4 in. in thickness, securely screwed to the lathing, or approved fittings or plates designed for the service, must be provided for switches, and also for fixtures not attached to gas pipes or conduit."

METAL MOLDING WIRING

160. Metal Molding Wiring for Finished Buildings. Although this is a relatively new product it has been used to some extent for finished-building wiring, particularly for extensions to existing installations where it is not desirable to mar the wall or partition as in Fig. 66. The molding is compact, Fig. 67, and is inconspicuous, particularly when painted to match the trim in the room where it is installed. For exposed wiring, metal molding presents a better appearance than any other material available. It is Sherardized and hence will readily take either oil or water-color paints. It can be easily fixed to any sort of a surface

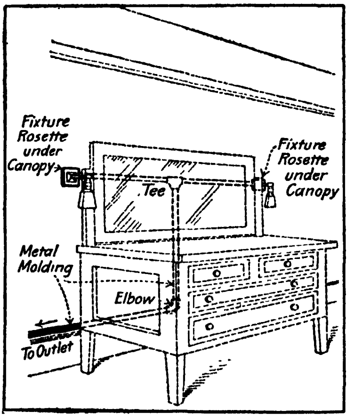


FIG. 66.—Installation of metal molding to serve brackets.

with either wood or machine screws or toggle bolts and a variety of fittings are manufactured which will adapt the product to almost any conceivable condition. It is likely that it will be widely used in the future for finished-building wiring. The molding can be arranged in panel effects and when so laid out it can be made to improve rather than to detract from the appearance of a surface. Fig. 67*A* shows an installation made along these lines.

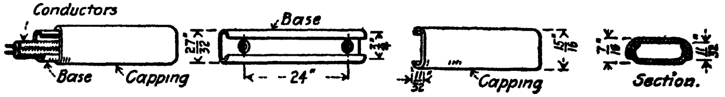


FIG. 67 —National metal molding.

161. Brief of National Electrical Code Rules Affecting the Installation of Metal Molding. Allowable wattage is 1320 and maximum voltage is 300. There is no specific rule relating to the number of circuits that can be carried in one molding but the National Molding will accommodate four No. 14 wires. Rubber-insulated wire must be used but single-braid wire is accepted. Where the molding passes through floors it must be protected against mechanical injury and moisture by an iron pipe as shown

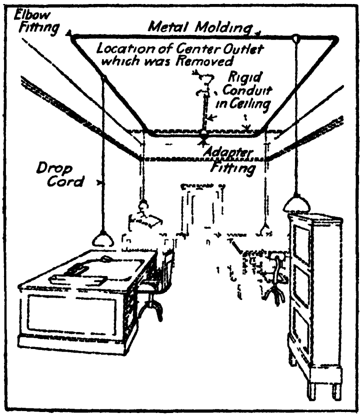


FIG. 67*A*.—Metal molding installed in a panel effect.

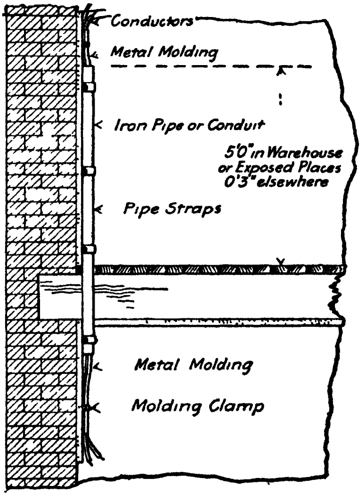


FIG. 68 —Metal molding through floor protected by iron pipe.

in Fig. 68. In warehouses, factories and similar places, the pipe must extend to at least 5 ft. above the floor, but in residences and where the possibility of injury is remote, an extension of but 3 in. is accepted. Frequently a length of conduit is inserted, by means of approved fittings, in the molding run where it passes through a floor. Metal molding may be run directly through partitions, without further protection, provided they are dry. The entire molding system must be electrically continuous and must be thoroughly grounded.

161a. Cost of Metal Molding Installations. The plain molding, not installed, costs about 4 cents per foot. Cost of fittings and labor vary with the nature of the job and of the surface on which the molding is to be mounted. Molding fittings cost less than equivalent conduit fittings. Single-braid rubber-insulated wire is approved and preferable for metal molding, which effects a saving as compared with conduit for which double-braid wire is required. A completed metal molding job will cost less than an equivalent conduit job on account of both the saving in labor and in cost of fittings. The greater the number of outlets the greater the difference in cost.

Cost of labor varies with the surface and with general conditions. Labor cost on the molding is 20 to 30 per cent. less than on conduit. A considerable saving in labor cost can be effected through the application of the punch and shear specially designed for metal molding work. Fifty cuts can be made with the shear in fifteen minutes while it requires in the nieghborhood of five minutes to make one cut with a hack saw. Where the wiremen are inexperienced in metal molding manipulation the total cost for the molding will be about the same as for conduit. Where the wiremen are experienced the total cost will run from 20 to 30 per cent. less.

WOODEN MOLDING WIRING

162. Wooden Molding for Finished-building Wiring. Although its use is prohibited in certain cities, wooden molding provides a method of wiring that is satisfactory for small residences and business houses—the places that the central station has difficulty in connecting because of the fact that the wiring must be installed at very low cost if the proposition is to be of interest to the prospective consumer. Wooden molding wiring is the cheapest of all of the methods except open wiring on knobs and cleats. The *American Electricians' Handbook* gives much data that cannot be included here in relation to the installation of wooden molding.

163. Brief of National Electrical Code Requirements Affecting the Installation of Wooden Molding. Its use is prohibited in damp places, in rooms where there are fumes or in elevator shafts. (Iron conduit should always be used in elevator shafts.) Approved fittings are made whereby molding wiring can be used in combination with the other methods. Single-braid, rubber-insulated wire must be used in molding. Where a circuit in molding runs into conduit, double-braid wire, spliced to the single-braid molding wire, must be used in the conduit. Where wire from molding runs into flexible tubing or loom, single-braid wire may be used in both molding and flexible tubing.

164. Different forms of wooden molding are shown in Fig. 69. Both two-wire and three-wire moldings can be obtained. The three-wire is seldom used except for three-way switches and for feeder runs from the entrance to the distribution center. For high-class work, molding and capping of a hard wood to match the trim of the room in which it is to be installed can be purchased. Soft-wood molding is much more easily obtained and installed. Capping, of various forms as suggested in the figure, can be purchased.

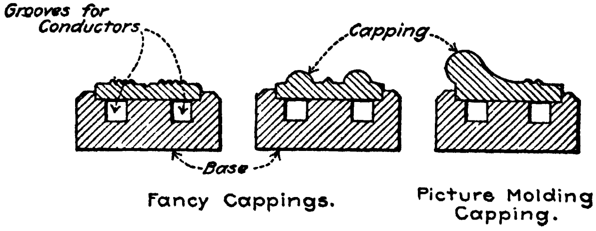


FIG. 69.—Commercial forms of wooden molding.

165. A method of wiring for a side outlet with molding is delineated in Fig. 70. The molding is carried along the baseboard to a point directly under the point where the side outlet, for either the switch or bracket, is to be located. The conductors are then fished from a hole, in the baseboard under the molding, to the outlet hole and are encased in flexible tubing.

166. The method of installing a fixture served through molding is shown in Fig. 71. A wooden *Ceiling-block*, about 5 in. in diameter, provides a substantial support to which the fixture crowfoot is secured with wood screws. The block is so grooved that the wires can be carried into the fixture without cutting the canopy.

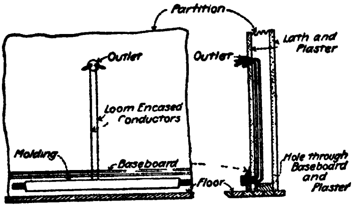


FIG. 70.—Molding wiring for a side outlet

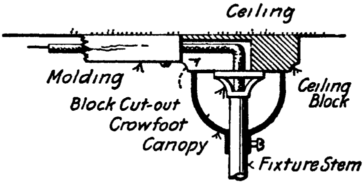


FIG 71.—Method of supporting a fixture.

167. Conductors can be carried concealed within molding to an electrolier when it is impracticable to fish within partitions. Fig. 72 illustrates a typical application of this method. The conductors are carried from the floor below up one corner and around the ceiling of the room in molding, and then are fished from point *A*-1, Fig. 72, to the electrolier outlet in the center of the room. An L-shaped piece should be cut out of the molding as

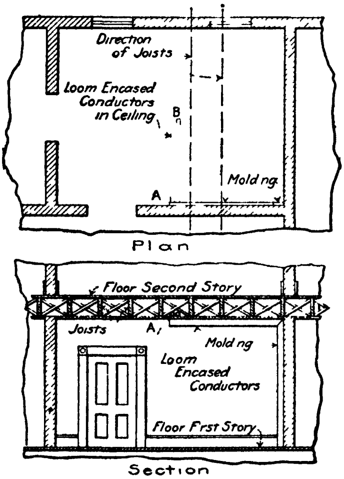


FIG. 72 —Conductors carried in molding to electrolier

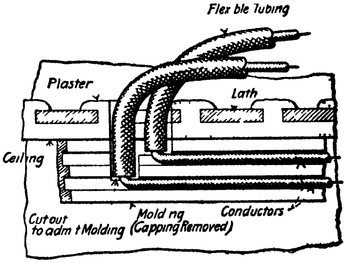


FIG. 73 —Detail where conductors enter molding.

indicated in Fig. 73 to accommodate the ends of the circular loom. This method of concealing conductors often is much less expensive than fish-wiring.

168. Wooden Molding for Extensions to Existing Installations. The method is very convenient for this purpose. Fig. 74 illustrates an example where it is used for increasing the number of outlets in an office-building room. The existing outlets have been tapped and molding, attached to the ceiling, is run to supply the new ones. The dead sections of molding—those which contain no wires and which were run merely to make the job present a symmetrical appearance—are shown shaded. In making such additions it is necessary to so plan the work that the *Code* limit of 660 watts per branch circuit will not be exceeded. The panel-box directory, if there is one, should be consulted and a sketch should be made indicating just how each branch circuit is to be extended and the route that it should take.

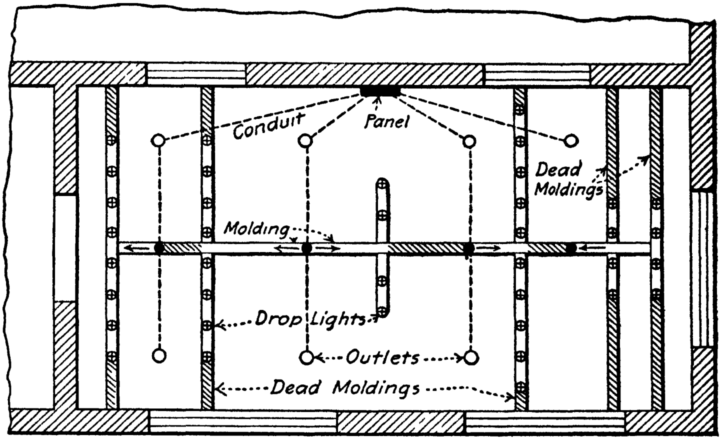


FIG. 74.—Extensions to wiring in an office using wooden molding.

169. A combination of wooden molding and flexible tubing for wiring an apartment is shown in Fig. 75. Flexible metallic conduit or flexible armored cable could be substituted for the flexible tubing where the increased cost is justified or where the use of metal conduit is compulsory. The flexible tubing is used for the portions of the installation where it can be readily fished in and wooden molding, fastened to the ceiling, is used for the balance. The circuits in the hall are in molding. Flexible-tubing-encased conductors are fished from the hall to the outlets.

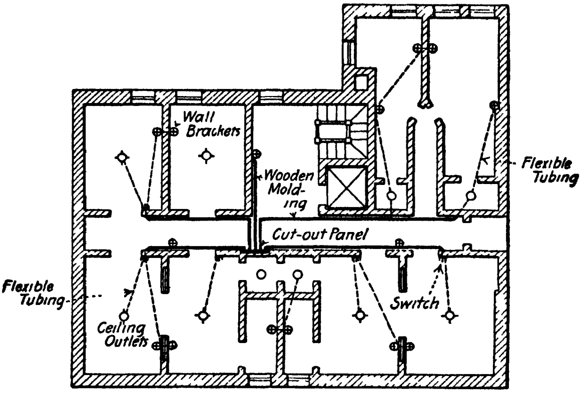


FIG. 75.—Wiring of an apartment using wooden molding and flexible tubing.

If the ceilings are furred the fishing can be very easily done. If metal conduit is used, steel boxes are required at all outlets and junctions.

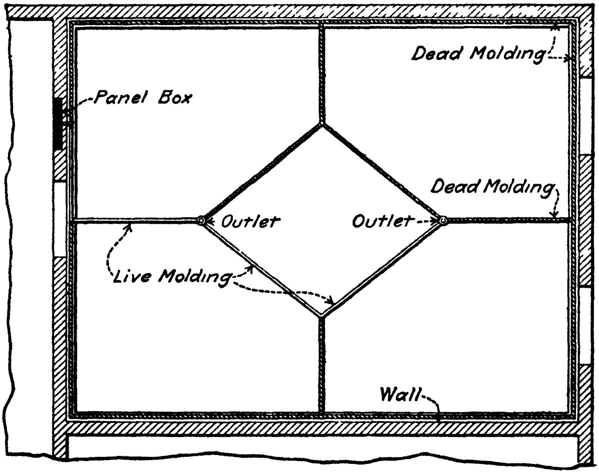


FIG. 76.—Use of dead molding to insure a symmetrical appearance.

170. "Dead" molding is often placed so that the installation will have a symmetrical appearance. Figs. 74 and 76 illustrate the idea. In Fig. 76 two outlets on the ceiling are fed in molding from the panel box. "Dead" molding with a picture molding capping (Fig. 69) is placed almost entirely around the room and much of the molding attached to the ceiling is dead. The molding that is shaded is "dead" and that shown white carries conductors.

METHODS USED IN EUROPE

171. Methods Used in Europe for Wiring Finished Buildings. This subject is covered quite thoroughly in a report "*The Successful Handling of the Small Customer in Europe*" read by its author, S. E. Doane, before the June, 1914, convention of the National Electric Light Association in Philadelphia. The complete report was published in *Electrical World* for May 23, 1914, and has been reprinted as a separate publication by the National Electric Light Association. Mr. Doane personally visited many European cities and gave the subject very thorough study. Tables, data and illustrations are included in his paper that outline very comprehensively the relation of the central stations to their small customers and the subjects of getting, maintaining and charging for the business where the buildings must be wired. Every central-station man should secure and study this report. It appears that the European central stations have thus far been more successful than those of this country in making profitable customers of the small consumers. One reason for this is, apparently, that they can install reliable and sightly wiring jobs at considerably lower costs than those that obtain here. For this reason an outline of the foreign methods should be valuable. Probably a low cost, inconspicuous method of exposed wiring similar to some of those described in the following paragraphs will be ultimately developed in this country. The information that follows is abstracted from Mr. Doane's report.

172. General European Practice. Flexible Cord on Glass Button Construction. The methods of wiring vary even within the same country. Flexible twin cord on glass buttons, one of the oldest wiring schemes, is still used when the installation must be very cheap or where extensions are made to existing installations in finished buildings; but there is a marked tendency in most places to discontinue this method in favor of more substantial construction. A number of central stations in Germany and Austria—for instance, in the whole northern part of Bohemia—are prohibiting the use of flexible cord and glass buttons.

173. For wiring small finished buildings at Milan, Italy, the method illustrated in Fig. 77 has been used. The picture shows a typical two-room installation. One lamp is supposed to be in each room. Wooden molding is used on the walls close to the ceiling for encasing the wires. The leads to fixtures and switches are in sheet-metal-covered, impregnated-paper tubes.

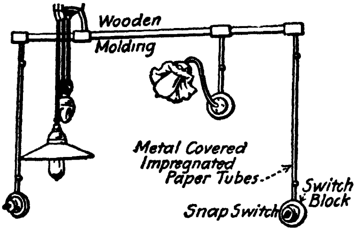


FIG. 77.—Fittings, wiring and fixtures used for a two-room residence at Milan, Italy.

174. The Bergmann Tube System. The tubes were made of paper impregnated with an asphaltum-like substance. In later years these were protected by a thin cover (0.01 in. thick) of iron or sheet brass. The tubes were laid on or under the surface of the wall and rubber-insulated wires were drawn into them. Under the German rules the use of unprotected Bergmann tubes is now prohibited. These tubes must now be covered with brass or iron. The metal cover, however, is very thin and does not afford much protection against nails.

175. The Peschel Tube System. One of the largest electrical firms in Germany, the Siemens-Schuckertwerke, introduced about thirteen years ago a system of enamel-covered steel pipes, with open seams to permit condensation to escape. These tubes, which are named after the inventor, are very thin, being about 0.03 in. thick. The weight of 100 ft. of tubes of 14-mm. (9/16-in.) inside diameter is less than 19 lb. This pipe is used on or inside the wall. The separate sections of tube, which are made in lengths of 10 ft., are joined to each other and to the fittings by means of couplings and held together, not by screw threads, for which the walls of the pipe would be too thin, but by the spring action of the open-seam steel pipe. The outside of the pipe is just a trifle larger than the inside of the couplings, and when inserting it into the latter the pipe must be slightly squeezed together.

In many instances this Peschel tube is used as a return circuit in cases where one of the conductors is grounded. In such a case, before joining the tubes and couplings together, the enamel of the former is scraped off as far as the coupling extends. Experience has shown that the electrical resistance of the system of steel pipes connected as described is far below the permissible maximum. The cross-section of the tubes is dimensioned with a view to giving them the proper current-carrying capacity.

176. The "Plaster Hose" System in Austria. This is an inexpensive system of wiring employed largely in stone and brick buildings. A groove 1 1/2 in. deep is chiseled into the plaster and brick, and a piece of very thick walled rubber hose, greased with soft soap on the outside, is laid in the groove. The whole is then plastered up and surfaced off smooth. Both ends of the rubber hose, however, extend from the plaster. After the plaster has hardened the rubber hose is pulled out, the soap preventing the plaster from sticking to it. The result is a hole extending under the surface of the wall through which the rubber-covered wires are fished. If junction boxes are required a block of wood the shape of a truncated cone is inserted into the plaster. After the plaster has hardened it is removed. The round hole in the wall is afterward covered by a piece of circular sheet iron maintained in place by two elastic metal strips riveted to the back of the sheet. The strips press against the side of the hole in the wall and keep the cover in place by friction. This cover may afterward be painted over or covered with wall paper, so that the whole installation when finished is practically invisible. This system, however, is now being superseded by the Peschel system, since the latter is only slightly more expensive and much more substantial.

177. Kuhlo wire provides a system which is rapidly superseding the other inexpensive wiring methods. It is particularly adapted for the wiring of existing buildings and for extensions to older installations that must be made with as little disturbance and dirt as possible. In this system two-conductor or three-conductor cable protected by thin brass or by thin lead-covered iron sheet is used. (See Fig. 78.) The thickness of this sheet covering is about 1/100 in. The metal is pressed around the insulated wire or cable and the edges are folded over one another so that a seam results running lengthwise of the wire. This seam, which is tightly pressed together, is water-tight for all practical purposes, and, on the other hand, the metal cover which takes the place of metal tubes in other systems of wiring is in close contact with the insulation, without leaving a pocket for condensed water.

For grounded return circuits the metal covering may be used as the return circuit. As the number of inside conductors of this kind of wire is one, two or three, the total number of conductors will be two, three and four respectively, in case the outer cover is used as a conductor also. The largest part of the material used is two-conductor wire, which means one or two inner wires, according to whether the outer cover is used as a conductor or not.

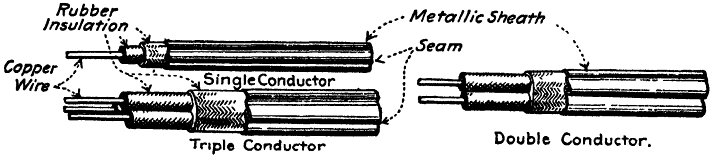


FIG. 78.—Kuhlo wire.

This wire was invented by Mr. Kuhlo, director of the electric central station in Stettin, and is marketed on a large scale by the Siemens-Schuckertwerke. A year ago six or seven other firms—among them the Allgemeine Elektricitäts Gesellschaft—started the manufacture of this wire under the name of "Rohrdraht," which means tube wire.

178. Installation of "Kuhlo" Wire. The wire can be erected in a number of different ways, either buried in the wall or cleated to the surface of the wall. The former method is at present not permitted, according to the literal wording of the German rules, which were made before the general introduction of the Kuhlo wire. In practice the scruples against burying wires in plaster do not seem to be shared generally, and many wiremen are concealing the Kuhlo wire when occasion demands. For this purpose a special tool, consisting of two 4-in. saws riveted together in parallel position so as to leave a space of about 1/4 in. between them, is used. This double saw cuts a clean groove in the plaster especially when guided by a straight-edge. The wire can then be placed in this groove and plastered in.

In most cases it is preferable to fasten the Kuhlo wire to the surface of the wall, not only for reasons of economy, but also because less disturbance and dirt will be caused that way in finished buildings with painted or papered walls. Kuhlo wire is unobtrusive in appearance. The thinnest wire with single conductor (capable of carrying 6 amp. under the German rules) has an outer diameter of only 4.3 mm., or less than 3/16 in. The wire can be run in the corners of rooms or along the frames of doors, windows and picture molding, rendering the installation inconspicuous.

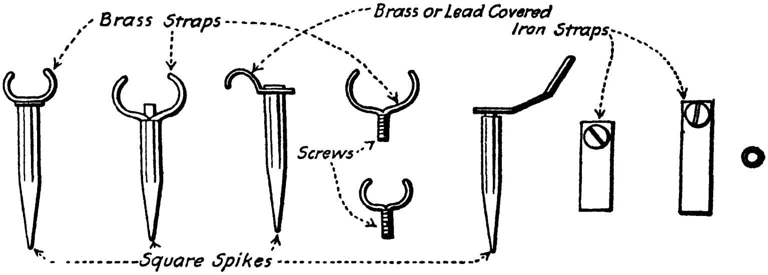


FIG. 79.—Fasteners for Kuhlo wire.

There are several methods in use for fixing Kuhlo wires to the surface of a wall, the simplest being to nail it down with proper staples. Other methods are permitted by the German rules, such as holding the wire down by straps (Fig. 79) which are made of brass-covered or lead-covered iron, in accordance with the material covering the wire. These straps have lugs on one side with holes in them. A piece of square steel or spike about 1 1/4 in. long having a tapped hole in its head is driven into the brick wall until its head is flush with its surface. The strap is then screwed down on the wall by means of a small iron machine screw turning into the hole in the center of the square piece.

Before screwing the strap down the wire is passed under it and then held in place. Instead of using rigid straps to fit the wire, flexible brass straps may also be used. These are bent around the wire after one end is screwed onto the steel spike. This has the advantage that the steel spikes can be driven into the wall along the path of the wire, whereas with the first-named type of straps the spikes must be driven in about 3/8 in. or 1/2 in. to the side of that line. The flexible straps, which are rolled manually around the wire, do not present as neat an appearance as do the others.

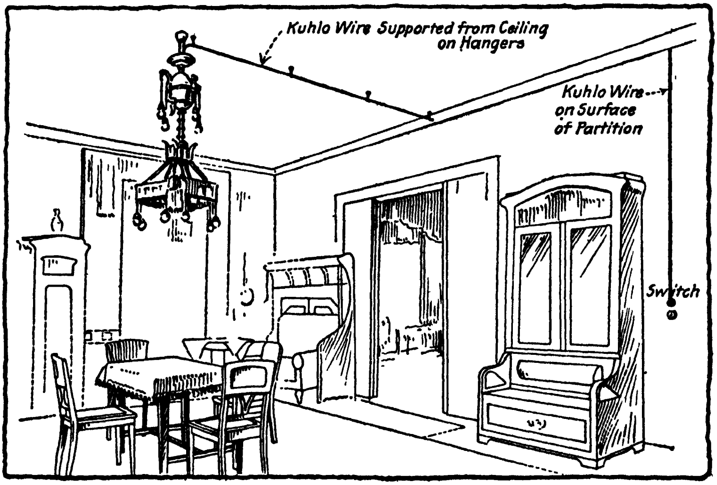

Kuhlo Wire Supported from Ceiling on Hangers
Kuhlo Wire on Surface of Partition
Switch

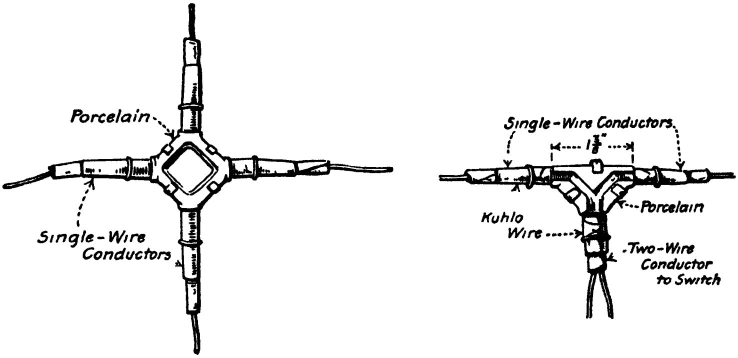
FIG. 80.—Installation of Kuhlo wire in a residence.

By a third method the Kuhlo wire is held to the surface with small soft-brass fork-shaped supports (Fig. 79) which also are screwed into the steel spikes and then pressed with pliers around the wire. On ceilings it is sometimes desirable to carry the wire about 2 in. or 2 1/2 in. away from the surface to avoid plaster ornaments as shown in Fig. 80, which also shows such carriers screwed into the ceiling and holding the wire by means of clamps.

The smaller types of single and double conductor, which are almost exclusively used in ordinary house wiring, can be bent by hand. Stronger wires must be bent with a special tool. Another handy tool is a pair of special pliers used when stripping the wire of its cover at the ends.

179. Outlet and Other Fittings for Kuhlo Wire. The outlet boxes for residences are made of porcelain. Where mechanical abuse is likely, or in dusty places, metal outer boxes are used, consisting of cast-iron bases with tight-fitting brass covers held in place by friction.

The porcelain fittings used for residence and other lighter work are of two types—one for soldered and the other for screwed connections. Both types have a sheet-brass base under the porcelain parts, which insures good electrical connection between the outer covers of all the wires entering into that outlet box, which connection is essential in case the metal coverings form part of the circuit. The connection between the sheet-brass base of the outlet boxes and the outer conductors of the Kuhlo wire is made in the same way as that of the inner conductors, namely, soldered or screwed, depending on the type of fitting used.



I. Cross Connection Box.

II. Tee Connection Box.

FIG. 81.—Fittings for Kuhlo wire.

The porcelain fittings, especially of the soldered type, are very small and unobtrusive in appearance. Fig. 81 shows a T-connection box with the cover off. It is used for connecting an ordinary single-pole switch into a horizontal one-wire conductor with grounded return circuits. The length of the porcelain piece is only 1 3/8 in. The vertical conductor which leads to the switch must be a two-wire conductor, since the return circuit passes unbroken through the metallic base of the T-fitting. It is not necessary to carry the grounded return circuit to the switch. Fig. 81 also shows a single-pole soldered cross-piece.

180. Economy and Applications of Kuhlo Wire. One of the great advantages of this method of wiring is its cheapness. When the method was new a prize competition was arranged and it was discovered that one wireman could run 200 ft. of Kuhlo wire per day. Since that time a record has been set of 650 ft. a day per wireman. Many kinds of installations other than residences have been wired on the Kuhlo system, such as public buildings, theaters, churches, schools, hospitals, factories, agricultural establishments, offices, hotels, castles, villas, ships and railway cars.

181. Wiring of Finished Buildings in England. A very large proportion, possibly 50 per cent., is of the so-called slip-joint tube wiring; that is, tubing which is not screwed. There are two distinct types of plain tubing, the first and cheapest consisting of a flat piece of steel bent into circular form so that the edges butt. This is known as split or closed-joint tubing. The second type is made up in the same manner except that in addition the edges are brazed together. It is known as brazed tubing. The fittings are either of cast steel or stamped.

Wooden molding is also used to a large extent in England, and still more so in France and Italy, whereas it is absolutely forbidden by the German and Austrian rules. It appears that in England also it is going out of use in favor of "Stannos" screwed tubing and wire-armored twin conductor. The so-called "Stannos" wire is equivalent to the Kuhlo wire in Germany. It consists of a rubber-insulated copper wire covered by a thin copper sheath which is rolled around the rubber in several layers (lengthwise, not in spirals) which are soldered together afterward, so as to form a solid, water-tight, seamless, tin-coated copper tube. The Kuhlo wire is a later type and is an improvement in so far as it is cheaper. In Germany it is not considered inferior to Stannos wire. Stannos wire is used more in England, whereas the German Kuhlo wire is used more in Germany. This may be due to climatic as well as to commercial causes. The moist weather prevailing in England may make an absolutely water-tight wiring material more desirable.

Screwed tubing is used for high-priced work and is either welded, solid-brazed or solid-drawn. Wire-armored twin conductors are considered most promising, but at present are too expensive. Flexible twin cord on glass or porcelain knobs has never been extensively employed in Great Britain and its use is being discontinued there just as in Germany and Austria.

CHAPTER VIII

PLANNING INSTALLATIONS

UNDERWRITERS AND MUNICIPAL REQUIREMENTS

182. The National Electrical Code requirements should be followed for all work unless there are local municipal requirements that conflict. A copy of these rules can be obtained by applying to any local fire inspection bureau or to The Underwriters' Laboratories, Chicago, Ill. In some cities municipal rules—in reality they are ordinances—are in force which take precedence over the *National Code* rules which have no legal standing. The local fire-inspection bureau and the central-station company will be informed about these things and should be consulted if there is any doubt.

183. Before considering the installation of knob and tube or molding work the authorities should be consulted because in certain communities the installation of wiring by these methods is prohibited.

GENERAL CONSIDERATIONS

184. Planning an Installation. Before any work is done on a finished-building wiring installation, the initial step is to make a survey of the premises. The lay of the floor beams and of the partitions should be noted and the wireman should, if possible, plan the run for every wire before he makes any openings in exposed places and before he locates his entrance. The cellar and the attic should be visited and all of the closets inspected. By thus carefully analyzing a building it is frequently possible to materially economize in labor and material. Sometimes a raceway, built for pipes or due to some builder's freak, can be located, which extends from basement to attic, which will accommodate the risers. Horizontal paths may, frequently, be similarly located. It may be necessary to bore some holes in attic or cellar and to remove a few boards in closets or in other unexposed locations and to probe with a mouse or fish wire to determine the most suitable routes for the wiring. In any case no holes for switch boxes or electrolier outlets should be made in walls or ceilings until the wireman is reasonably sure that he can get his conductors to them. Some skillful old-building wiremen never make a hole for a switch outlet in a wall or partition until the raceway for the conductor is complete, down within the partition to the switch, and a mouse has been dropped down and sounded within the partition for verification.

185. Selection of the Point of Entrance, Meter and Distribution-center Locations. The meter loop should, generally, be located in either the kitchen, pantry, or cellar. In the smaller houses, the tablet board should be located near the meter and in the larger houses, where there are a number of branch circuits, at the central point of distribution (see Par. **189**). The point of entry should be located with reference to the accessibility of the service connection. The run between the entrance and the meter location should be of minimum length.

186. Installation of Entrance Wires. Where entrance wires pass through the walls of a frame house, porcelain tubes are used, one for each wire. Porcelain tubes sometimes are installed at entrances to brick houses. An iron conduit entrance tube should, preferably, be used. It is then necessary to drill but one hole through the wall for conduit, whereas for tubes two holes are necessary. Outlet fittings are required for the conduit, which increases the cost, but because it is necessary to drill only one hole the conduit is often cheaper than tubes and affords a neater job.

187. Routes for Conductors. In upper-floor circuit wiring the most generally adopted method is to bring one, two or more circuits—according to the load—from the distribution center to the attic, whence they are dropped through ceilings and walls to the various bracket, fixture, and switch outlets. Running conductors to first-story outlets is a more difficult task, as it often necessitates the removal of flooring and the utilization of other methods to avoid the permanent mutilation of walls and ceilings. Fig. 179 shows the route followed by concealed conductors in the wiring of the typical five-room frame dwelling.

188. Calculation of Wire Sizes. This subject is too extensive to be treated in detail here. For complete information the reader is referred to the *American Electricians' Handbook.* No. 14 wire is used almost universally for incandescent lamp branch circuits unless the circuits exceed 100 ft. in length, in which case No. 12 wire is used. If a wire is too small, while it may safely carry the current without exceeding the *Code* limits, the voltage drop in it will be so great that the lamps will burn dimly. No. 14 wire is the smallest size that is permitted by the Underwriters. The size of wire that should be used for the run between the entrance and the distribution center is usually determined by the current that is to be carried—that is, by the number of lamp sockets and other current-using outlets installed. Unless this run is quite long, wire of a size that will safely carry the current in accordance with the *Code* table (Section No. 18) can be used and the voltage drop in it will not be excessive.

BRANCH CIRCUITS, DISTRIBUTION CENTERS AND PANEL BOXES

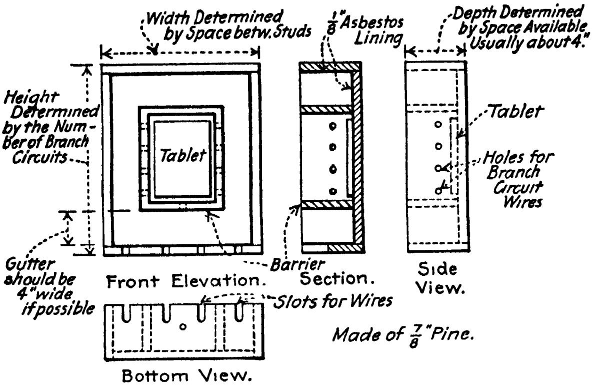
189. Determination of the Number of Branch Circuits Necessary. The National Electrical Code rules specify that cut outs "*must be so placed that no set of small motors, small heating devices or incandescent lamps, whether grouped on one fixture or on several fixtures or pendants (not more than sixteen sockets or receptacles), requiring more than* 660 *watts, will be dependent on one cut out.*" In practice it is not usual to connect more than twelve sockets on any one branch circuit. Therefore to determine the number of branch circuits necessary: Divide the total number of sockets and receptacles by 12 and the quotient will indicate the number of branch circuits necessary. It does not pay to crowd sockets on branch circuits to the limit, because this course may render the installation of additional outlets, which will probably be required sometime, very expensive. In general the sockets should be assigned to the branch circuits so that the loads on all of the circuits will be about equal. See **296** for an example installation.

190. The chief difference between the wiring of a large house and a small one is that the greater number of branch circuits in a large house necessitates the use of a panel box. In all houses the wires which lead from the distribution center are carried within floors and partitions in much the same way. Outside brick walls cannot, however, unless they are furred, be utilized without much expensive cutting of plaster and brick and damage to the finish.

191. A panel-box distribution center should be installed at a central location in all finished buildings requiring four or more branch circuits (a maximum load of 660 watts being permitted on each branch, see Par. **189**). The panel box proves a time, labor and money saver in repair work, as the concentration of all the cut outs at one location makes it a comparatively simple matter to find trouble on the wiring system. Furthermore, there is an obvious advantage in having all of the cut outs enclosed in a fireproofed case.

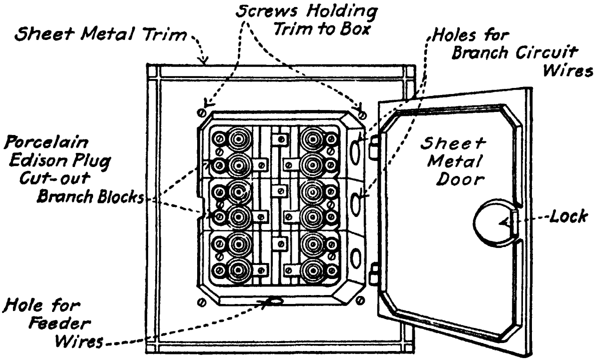
192. Panel boxes or distribution centers should be located as near the center of the building as feasible so that all of the branch circuits will be as short as possible. In a one-story building the distribution center—a branch block or two—can usually be located near the meter at the entrance or in a hall. In a two-story building the best location is usually in the stairway to the cellar or in a rear hall. In one of three stories, the second-story hall, as shown in Fig. 181, is usually the best location. Where there are more than three stories, distributing centers can be effectively placed on every other or on every third floor. The above applies to residences which usually have relatively light lamp loads. In office buildings or other places where the lamp load is dense it may be necessary to locate one or more panel boxes on every floor.

193. Construction of a Panel Box. Its location having been determined, a panel box, as illustrated in Fig. 82, can be built to fit the dimensions of the space available. The slate tablet which carries the main switch and fuse holders (or instead porcelain cut outs) is the only part of the equipment which it is necessary to purchase. The box can be made by either wireman or carpenter. The 1/8-in. asbestos lining is held in place with glue or flour paste. A wiring gutter is not absolutely essential, but it is desirable in that it permits the inside of the box to be wired more neatly. The box is held in place in the partition with wood screws and is so placed that its outer edge is nearly flush with the surface of the plastered wall. In finished-building wiring, the panel box should be made to fit the space within which it is to be placed. In new work the reverse is true; a space is made to fit the box. Boxes can be purchased from electrical supply dealers that work in nicely in finished-building installations. The all-metal box of Fig. 83 is low in price and of good construction. However, due to the fact that in old-building wiring "*the box must or should be made to fit the space,*" it has generally been found quite satisfactory to use the "home-made"



Width Determined by Space betw. Studs
$\frac{1}{8}$" Asbestos Lining
Depth Determined by Space Available, Usually about 4"
Height Determined by the Number of Branch Circuits
Tablet
Tablet
Holes for Branch Circuit Wires
Gutter should be 4" wide, if possible
Barrier
Front Elevation.
Section.
Side View.
Slots for Wires
Made of $\frac{7}{8}$" Pine.
Bottom View.

FIG. 82.—Details of panel box.

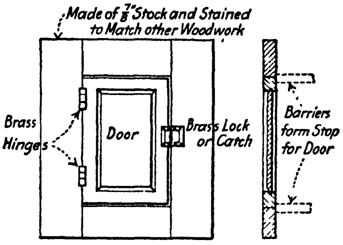


Sheet Metal Trim
Screws Holding Trim to Box
Holes for Branch Circuit Wires
Porcelain Edison Plug Cut-out Branch Blocks
Sheet Metal Door
Lock
Hole for Feeder Wires

FIG. 83.—A sheet-metal panel box.

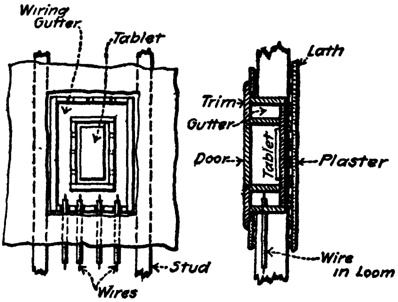
article. Before the box is placed in the wall slots should be cut in the ends and holes should be bored through the barriers for the accommodation of the conductors.

194. Construction and Installation of the Panel-box Trim. The trim or outer frame for a panel box, pictured in Fig. 84, should be very neatly made by a skilled carpenter and should be of material similar to, or finished to match, the adjacent woodwork. It is not usually feasible to purchase the box and trim ready-made because each installation, ordinarily, is different from others as to dimensions or in some other respect. The trim should be made of such dimensions that the barrier of the box forms a stop for the door—if the box has a gutter. If no gutter is provided the sides and ends of the box form the door stop. The sides of the trim should extend about 6 in. beyond the sides of the box to cover broken plaster and insure a neat appearance. The latch and hinges should be made of brass and the door should be paneled to prevent warping. The trim is held to the box with round-head brass wood screws.


Made of 7/8" Stock and Stained to Match other Woodwork
Brass Hinges
Door
Brass Lock or Catch
Barriers form Stop for Door

Front Elevation. Section.

FIG. 84.—Details of panel-box trim.



Front Elevation. (Trim Removed)

Tranverse Sectional Elevation. (Trim in Place)

FIG. 85.—Panel box in position in partition.

195. Installation of the Panel Box. As shown in Fig. 181 the panel box should be installed in the most central location available—preferably in the partition of a hall or closet. The service wires pass through the entrance switch and meter and thence to the panel box. If a main switch is also desired it can be located on the tablet in the panel box. From the panel box the branch circuits radiate in all directions and are carried within floors and partitions. The panel box in position is shown in Fig. 85. The box is held in the partition with wood screws.

196. Holes for Wrought-iron Conduit in Panel Boxes. The holes should be bored before the box is fitted into the partition. The holes should be located at the points where the conduits will enter. Each hole should be 3/8 in. larger in diameter than the nominal size of the conduit that it is to accommodate. The nominal diameters of conduits are the approximate inside diameters. All sizes up to and including 1 1/2 in. diameter have walls approximately 1/8 in. thick. This 1/8-in. wall thickness adds 1/4 in. to the nominal diameter. Then, allowing 1/8 in. diametral clearance, the hole for the conduit should be 3/8 in. larger than its nominal diameter as above noted. This does not apply for conduits larger than 1 1/2 in. Ordinarily, 7/8-in. holes are drilled for 1/2-in. conduit.

BUILDING CONSTRUCTION

197. The finished-building wireman should have a knowledge of the construction of buildings. If he knows how buildings are framed, what timbers are concealed within the walls and partitions and how these timbers are arranged, he can do his work much more quickly and with less damage to the building than if he does not possess such knowledge. Obviously it is impossible to give here any extended treatment of Building Construction. A few typical details will be shown and described. They can be of a general character only, because different methods of framing and constructing are in use in different parts of the country and, even in a given community, different contractors will apply different devices for accomplishing a certain result. The wireman should carefully study buildings being erected in his city until he is thoroughly familiar with the details of their construction.

198. Framing of wooden buildings varies in different parts of the country, but the methods shown in Figs. 86 and 87 are typical of those in general use. The wall construction of Fig. 87*I* is much the best for the finished-building wireman because it provides an unobstructed runway between the studs from the attic

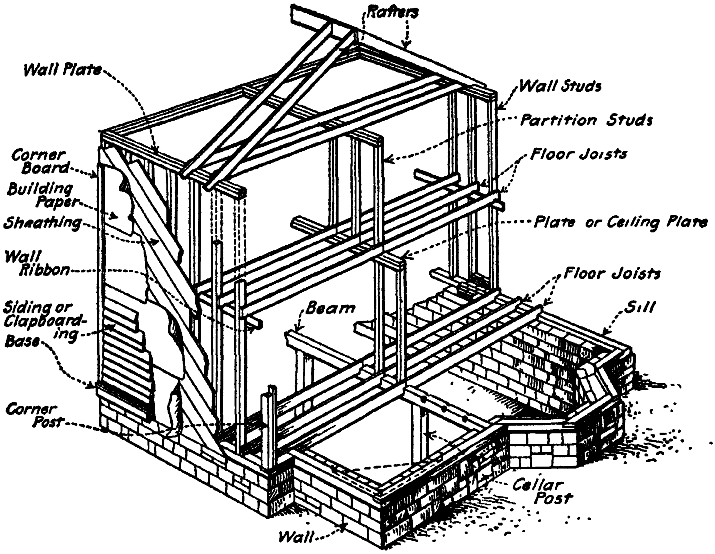
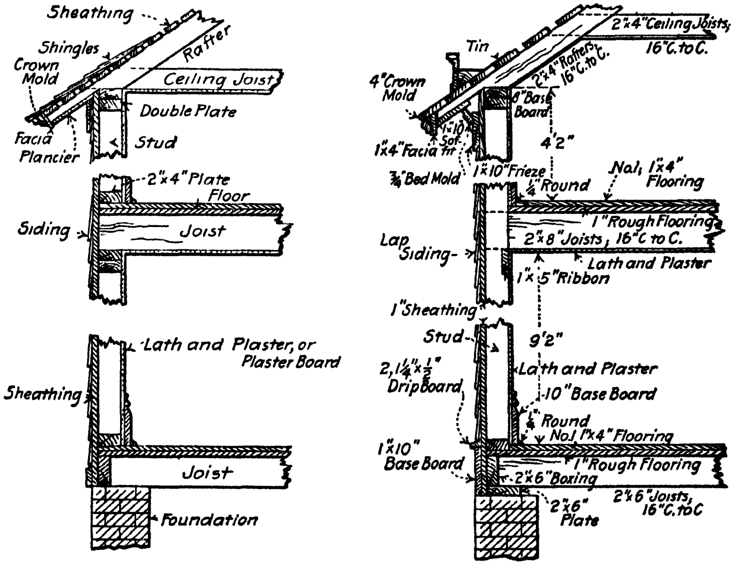


FIG. 86.—Typical framing of a wooden building.



I. Non-Continuous Wall Studs. II. Continuous Wall Studs.

FIG. 87.—Wooden wall construction of two types.

to the floor of the first story. Sometimes the construction is such that this runway extends clear to the basement.

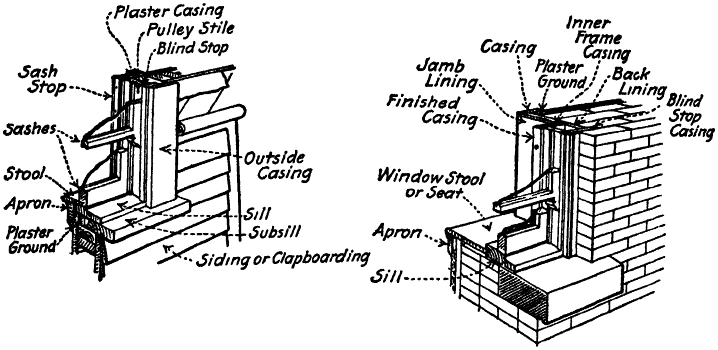


FIG. 88.—Construction around windows.

199. Typical construction around windows is shown in Fig. 88. The window frame in the wall of a frame building is usually made as shown in Fig. 89.

199a. Furring Strips (Fig. 89*A*). Furring consists of flat strips or pieces of wood varying in different cases from 1/2 in.

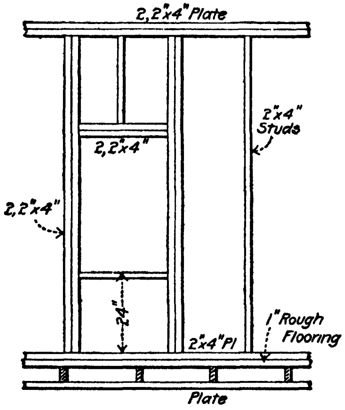


FIG. 89.—Construction of a window frame.

to 7/8 in. in thickness. The strips are used to bring irregular or interrupted work to a regular or even arrangement or surface or to provide an air space. They are used in most parts of the country in ceilings in high-class buildings. In the eastern section of this country they are used to a large extent on outside masonry walls to exclude moisture and to prevent the entrance of heat or cold. As shown in the illustration, the spaces provided by furring strips furnish ideal raceways for conductors, particulary flexible armored cable (see **143a**), for finished-building wiring installations.

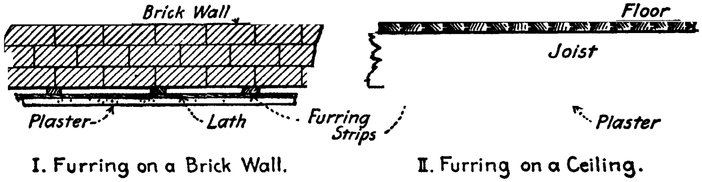


FIG. 89*A*.—Furring strips.

THREE-WAY AND EMERGENCY SWITCH CIRCUITS

200. For hall lighting, three-way switch circuits are usually installed so that the hall lamps can be controlled from either the first or second floors as shown in Fig. 90. Sometimes installations are made wherein the hall lamps are controlled from three or more points. Such control requires 2 three-way switches and as many additional commutating or four-way switches as there are additional control points. The running of the wires for

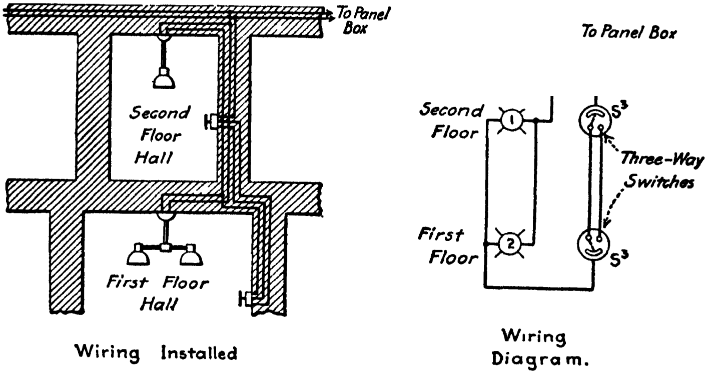
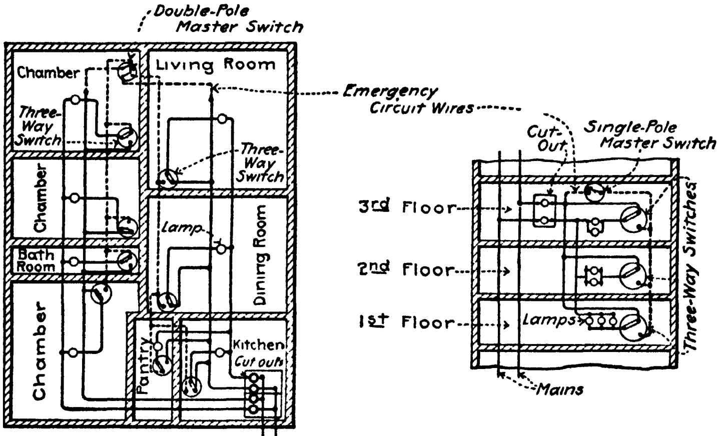


FIG. 90.—Wiring for hall lamps with three-way switches.

this form of control in an old house involves no features different from those ordinarily employed in such installations.

201. Emergency or burglar circuit wiring in finished buildings is readily effected by one of the methods illustrated in Figs. 91 or 92 or by a similar one. An emergency circuit comprises an arrangement whereby certain designated lamps, or all of the lamps, in a building can be lighted simultaneously, regardless of the positions of the individual switches, by throwing a master switch, which is usually located in the owner's room. Such provision is very desirable in case of fire, an attack by house breakers or other



(*Note. The Dotted Lines represent the Wiring that must be added to provide Emergency Control.*)

I. Two Emergency Circuits and D.P. Master Switch.

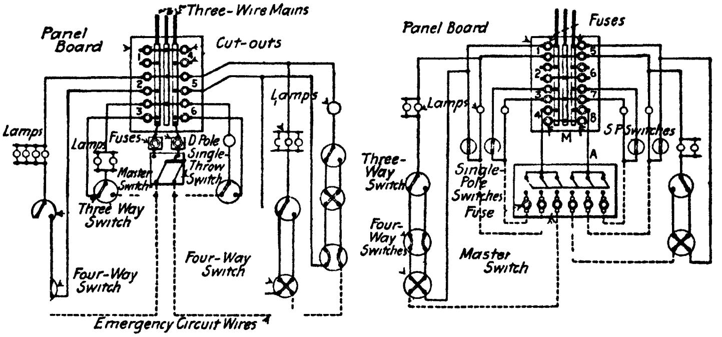
II. One Emergency Circuit and S.P. Master Switch.

FIG. 91.—Wiring for emergency circuits in a finished building—two-wire system.

emergency. To insure positive operation of the scheme, keyless sockets should be used at all lamp outlets and the sockets should be of the type in which the lamps can be locked. This is to prevent their being extinguished by being unscrewed. The service switch box should be locked so that its switch cannot be opened by unauthorized persons. In the illustrations, the dotted lines indicate the wiring that must be added to convert ordinary lighting circuits into emergency circuits. The circuits are discussed in detail in the paragraphs that follow.

202. Emergency Circuits for Two-wire System Installations. Typical ones are shown in Fig. 91. It is necessary to run an additional wire to each switch position and to substitute a three-way switch for each old single-pole switch. Where three-location-control circuits exist, it is necessary to substitute a four-way for one of the old three-way switches as indicated in Fig. 92.

The method shown in Fig. 91, *II*, should not be used for an emergency circuit involving more than 660 watts, because this is the maximum capacity permissible on a single-pole switch, hence the method should not be used for an emergency circuit involving more than one branch circuit. The wiring of any one branch circuit (that is, a circuit served through its own individual cut out) should not be mixed with the wiring of another branch circuit through the medium of an emergency circuit unless the emergency circuit is independently fused as in Fig. 92, *I*. Underwriters' inspectors will not usually permit such mixing unless fuses are used as shown. Where the load on the emergency circuit exceeds 660 watts, or where more than one branch circuit is involved, two or more single-pole master switches can be used



I Three-Way and Four-Way Switches Substituted for Old Single-Pole and Three-Way Switches Respectively

II Single-Pole Switches Remain Four-Way Substituted for Three-Way Switches in Certain Instances

(Note The Dotted Lines Represent the Wiring which must be Added to Provide Emergency Control)

FIG. 92.—Wiring for emergency circuits in a finished building—three-wire system.

as in Fig. 91*I*, thus suitably subdividing the load. Or a modification of the methods of Fig. 92 can be used. The emergency circuit may be tapped to the house circuit wire at any convenient point.

203. Emergency circuits for three-wire system installations are shown in Fig. 92, *I* and *II*. Both methods have been accepted by Underwriters' inspectors in certain localities. Which should be used in any particular case is a matter of cost and convenience. In the method of *I*, one double-pole master switch (it may be a single-throw knife switch, or a flush push-button switch) is used for the master switch. The old single-pole switches are replaced by three-way switches and the old three-way switches at the ends of two- or three-location-control groups are replaced by four-way switches. Note that the emergency-circuit wires are fed through their own fuses.

In 92, *II*, a single-throw, fused, knife switch, having as many blades as there are branch emergency circuits, is used for a master switch and the old single-pole switches are utilized, but new four-way switches must be substituted for the old three-way switches at the ends of two- or three-location-control groups. With either of the schemes of Fig. 92 the emergency circuits should be about equally balanced on the two sides of the three-wire circuit. In the cut outs 6-amp. fuses may be used.

CHAPTER IX

TOOLS AND MANIPULATION

NEATNESS AND HOW ATTAINED

204. The necessity of neatness in finished-building wiring need hardly be mentioned. Usually the buildings that are being wired are occupied and furnished and the tactful wireman will subject the occupants to a minimum of inconvenience and will make as little débris as possible.

205. Cloths should be carried by wiremen to catch the dirt made when cutting outlets. Heavy muslin or, preferably, canvas are suitable materials and the cloths should be at least 6 ft. square. They are sometimes termed "drop cloths." Whenever the wireman proposes to cut a hole for a partition or wall outlet the cloth should be so spread out (Fig. 92*A*) as to catch the dirt resulting therefrom. The same procedure should be followed for a ceiling outlet and in addition one of the devices described in the following paragraphs should be used.

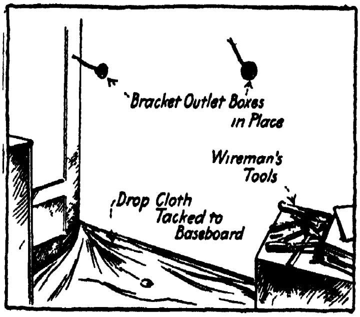

Bracket Outlet Boxes in Place
Wireman's Tools
Drop Cloth Tacked to Baseboard

FIG. 92*A*.—Illustrating the use of the "drop cloth."

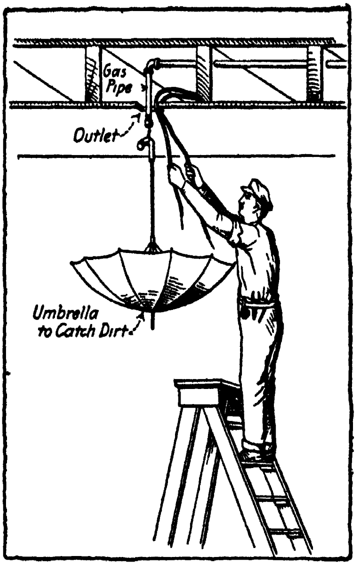


FIG. 93.—Umbrella used for catching dirt at a ceiling outlet.

206. An inverted umbrella makes a good dirt catcher when the wireman is working around ceiling outlets. Its application is illustrated in Fig. 93. Where a gas pipe extends from the outlet, the umbrella can be tied to it as shown. Where there is no object at the outlet to which the umbrella can be tied a helper can hold it or it can be supported between a couple of chairs. If the outlet hole is made, the umbrella can be supported by a string tied to the middle of a short stick, the stick being pushed into the hole and allowed to rest on the lath and plaster so as to bridge the hole with the string extending down and through.

207. A device to keep chips and dirt off of the floor and out of the eyes of the workman boring a ceiling can be made as shown in Figs. 94 and 95. When completed it is attached to the bit shank as shown. It catches all the débris which falls while the hole is being bored. To construct the device, cut a funnel-shaped cavity in the end of one cork as in *A* of Fig. 94 and cut the end of the other cork cone-shaped as *B*. Split each cork carefully down the center, *C* and *D*. Cut a groove lengthwise down the center of the flat side of the split corks *E* and *F* so that the pieces when put together will clamp around the shank of the bit, and make another groove around the curved surface of the corks for rubber bands which will hold the pieces together around the bit shank.

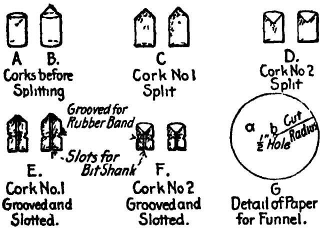


FIG. 94.—Parts of holder for dirt-catcher.

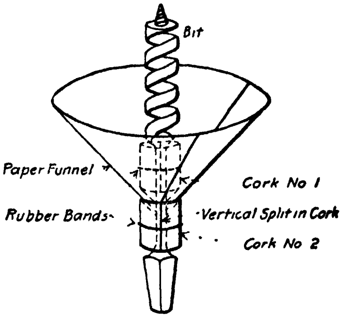


FIG. 95.—Dirt-catching device assembled.

A 1/2-in. hole is then cut in the center of a circular piece of cardboard, about 12 in. in diameter, and the cardboard is slitted along the straight line shown in *G*. Edge *a* is then drawn over edge *b* until a funnel is formed having about the same angle as the funnel-shaped cavity cut in the cork *A*. The cardboard funnel is slipped over the shank of the bit so that the cutting end of the bit will project through the inside of the funnel. A support for the funnel is formed by clamping the cork having the funnel-shaped cavity in its end around the bit, on the outside of the cardboard funnel. Inside, the cork with the cone-shaped end is similarly attached. The assembled device is shown in the illustration.

207a. A cone-shaped reflector or shade can be used as a dirt catcher. The small end of such a metal shade or reflector can be slipped over the chuck of a bit brace and securely taped there. The dirt falling from a hole being bored can be collected in the shade in the same manner as it is collected in the cardboard funnel described in the preceding paragraph.

REMOVAL OF FLOOR BOARDS AND THE MAKING OF POCKETS

208. Chisels for removing floor boards are shown in Fig. 96. They are forged from hexagonal steel bar and are not ordinarily obtainable on the market. Wide-bladed carpenter's wood chisels can be used but sometimes they are too highly tempered for rough work. Any blacksmith can forge the chisels shown in the illustration. Both of the sizes shown should be in the tool kit because usually two chisels are necessary for removing floor boards. The short chisel is 6 in. long and the other 13 in. which is a convenient length, although they are sometimes made as long as 24 in.

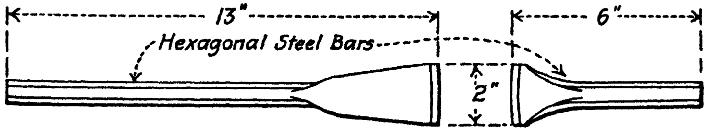


FIG. 96.—Chisels for removing floor boards.

209. A floor saw for removing floor boards is shown in Fig. 97. The point should not be wider than 1/4 in. so that a saw cut can be started from a small hole. The blade should not be longer than 8 in. If it is longer there is a possibility of its being pushed through a plaster ceiling when sawing a board of the floor above. The blade of the saw should be thin so that when a cut is made with it a minimum amount of wood will be removed. Furthermore, the teeth should be fine to insure a smooth cut. A thin-bladed, fine-tooth saw is necessary, particularly with hard wood, for neat work.

209a. A Flooring Saw for Finished-building Wiremen. The usual procedure in making a pocket in a wooden floor is to first bore a hole through the floor boards with a bit or to punch a hole with a small chisel. Then from this hole a cut is made with a key-hole saw. This method is entirely satisfactory for ordinary work, but where the floor is of hardwood, or finely finished, the hole from which the cut was started, and the wide slot made by the relatively thick key-hole saw blade that is ordinarily used, leaves a blemish that is usually very conspicuous. A special flooring saw is manufactured with which finished-building wiremen should be familiar. It is shown in Fig. 97*A*. The feature of the tool is that the back edge of the blade is rounded and has teeth cut in it. These teeth are for the purpose of starting a saw cut without the use of an auger, compass-saw or chisel.

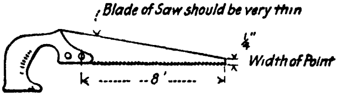


FIG. 97.—Floor saw.

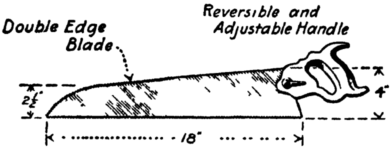
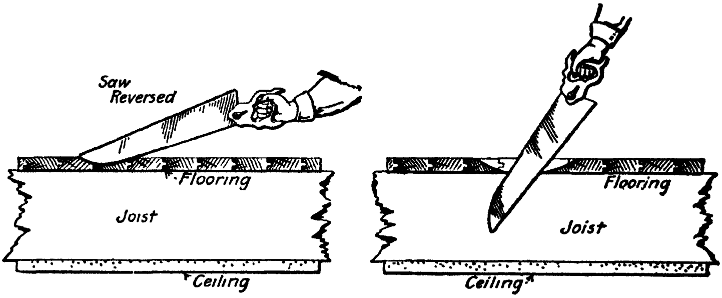


FIG. 97*A*.—Special flooring saw for finished-building wiremen.

The cut is started as shown in Fig. 97*B*, and the sawing action is continued with the tool held as shown at *I* until the flooring is cut entirely through, for a distance of possibly 4 or 5 in. Then the saw is reversed and the cutting is continued with the straight edge of the saw, to the width desired, as shown at *II*. The handle of the saw is reversible and adjustable, that is, it can be removed and turned around so that either edge of the saw can be used to the greatest advantage, or it can be rotated around a pivot to any reasonable position and there clamped. This feature permits each workman to adjust the relation between the saw and the handle to the position most desirable for him, and also allows the tool to be used in difficult and cramped positions. The ball and ratchet that holds the handle to the blade is so designed that the handle can be adjusted and clamped in any desired position almost instantaneously.



I Starting the Cut II. Finishing the Cut.

FIG. 97*B*.—Manipulation of the special flooring saw.

210. The first operation in removing floor boards is with a chisel. Before making saw-cuts across the floor boards to be removed, a chisel is driven through the floor board at its edge and close to a joist. Such a point is located by sounding along the board with a hammer. Fig. 98 illustrates the method. Some

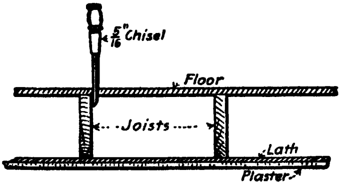


FIG. 98.—Method of starting cut with chisel.

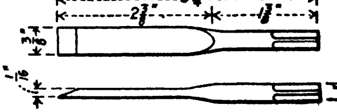


FIG. 99.—Chisel for cutting starting hole.

workmen begin by boring a hole, but this is not advisable. A 5/16-in. carpenter's wood chisel can be used to make the starting hole, but a better tool is shown in Fig. 99. This is a small chisel from a pocket tool-holder outfit and was designed for use in a handle with chuck jaws, but it is an admirable tool for starting saw-cuts because the blade is very thin. In use, the chisel is held in the proper location and tapped with a hammer until it pierces the floor. It is then withdrawn and the cut is continued across the board, as shown in Fig. 100, with a keyhole saw. (See Fig. 97.) With soft-wood floors, a small screw driver can be driven through to make a starting hole in lieu of a chisel. In first-class work where a thin-bladed chisel was used it is practically impossible to find the starting hole after the installation had been completed.

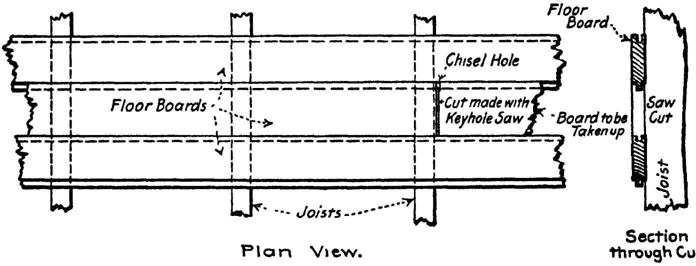


FIG. 100.—Saw-cut across floor board.

211. Taking up Soft-wood Flooring. After saw-cuts have been made across both ends of a floor board a chisel (about 1 1/2-in. blade) is driven through near one end, as shown at *A* in Fig. 101, and a prying movement will start the board. Then a chisel, having a width of 4 in. so as not to crush the adjoining board, is driven in as shown in Fig. 101 at intervals along the board and the edge of the board pried loose from the floor at each insertion. Often by driving in the chisel as at *A* and then giving the adjacent board *C* a few smart blows with a hammer the lower

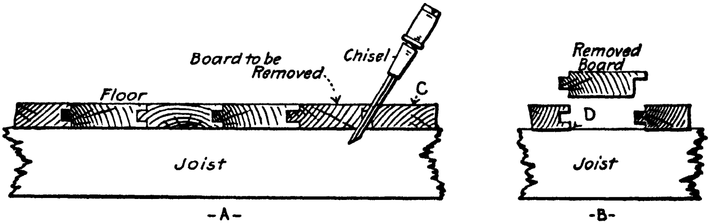


FIG. 101.—Method of removing floor board.

projection forming the groove will crack off for the entire length of the board so that it can readily be taken up. It is always good practice to break off the lower projection of the groove, Fig. 101. When the board finally comes up it appears as shown at *B*.

The groove side of the entire length of the board should be raised before the tongue side is raised. If the tongue side of the board is raised first the upper part of the groove that projects from the adjacent board may be broken off. The nails are always driven through the tongue. A chisel can be inserted at each beam, under the board at the tongue side. By pyring on the chisel the nails through the tongue can be loosened or withdrawn.

Some wiremen cut off the tongues of boards that are to be removed with a saw so that the boards can be lifted directly out with practically no prying. It is better, however, to split off the lower portion of each groove, because this method requires less time and gives a neater appearance. The tongue projecting under each half groove constitutes a stop, and the crack above soon fills with fine dirt, making it uniform in appearance with other cracks in the floor. If the tongue is sawed off the fine dirt drops through and an open crack is always visible.

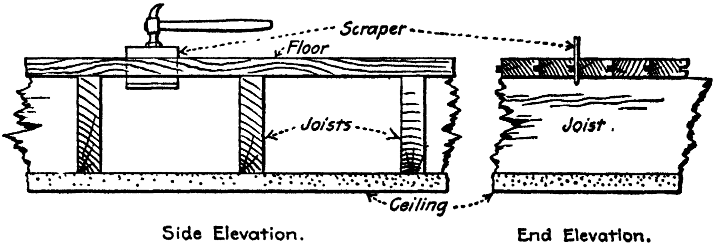


FIG. 102.—Cutting floor board tongues with scraper.

212. Taking up Floor Boards with an Ordinary Carpenter's Scraper and Hammer (Fig. 102). The tongue can often be cut the entire length on both sides of the board without leaving marks on the surface of the floor. The cutting should extend a foot beyond the point where the board is to be taken up. The board can then be raised and cut off at a joist. The scraper used for this purpose is strong enough even to cut nails. One edge should be filed or ground to a cutting edge. A detail is shown in Fig. 103. With this method the tongue is, of course, cut off of the floor board, which condition has the disadvantage referred to in the preceding paragraph.

213. In removing floor boards by sawing off the tongue the procedure is as follows: First a slot must be made in the seam between flooring boards of sufficient size to enable the floor-saw blade (Fig. 97) to be inserted. This is best done with a sharp, narrow chisel having a 5/8-in. blade. Then the saw blade is inserted, and the tongue at the junction of the flooring boards is sawed off the full length of board to be removed. The wireman can tell when he reaches the joist at which he wishes to end his cut. At this point the chisel blade is placed with the flat part across the board at edge of the joist, and another small slot made. Then the board is sawed off even with the joist, and can be easily removed with a floor chisel (Fig. 96).

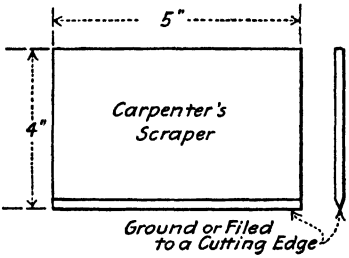


FIG. 103.—Detail of reconstructed scraper.

214. Taking up Finely Finished Tongue-and-groove Flooring. As such a floor is very difficult to take up without disfigurement, a skilful carpenter should, ordinarily, be employed to do the work. Where a floor composed of hardwood strips about 1/4 in. thick nailed to a soft-wood base, or a parquet floor over a soft-wood base, is encountered, wiremen sometimes have removed the hardwood pieces and replaced them without damage. If a wide chisel is inserted at the end of a hardwood floor strip it is often possible to raise the entire strip, as the brads used in securing the strips are small and have little holding power in soft wood.

215. Making a Pocket into the Space in a Partition. After a small hole has been cut in the partition at the point where the fixture outlet is to be located and a "mouse" dropped down through the hole to the floor to insure that there are no obstructions within the partition, a pocket is made by removing a floor board. The pocket is located adjacent to the point where the wires within the partition are to pass through the floor. A floor-board piece is cut out, as shown in Fig. 104. The "quarter-round" at the baseboard is removed for a few feet and one saw-cut is made through the floor board that is to be removed close to the baseboard, where it will be covered by the "quarter-round." The other saw-cut through the floor board is made close to a joist several feet from the partition.

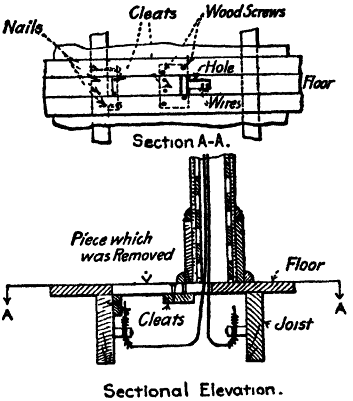


FIG. 104.—Method of running wires from floor pocket to partition above.

After the floor board has been removed a hole is chiseled under the partition, through which the wires are drawn. In replacing the removed floor board, two cleats are used to support it. The cleat at the end of the board farthest from the partition is nailed to a joist as hereinafter described. The cleat at the end near the partiton is held up with flathead wood screws driven in from above. Although the removed floor board shown in Fig. 104 extends only to the first joist away from the partition, it is better practice so to cut a floor board that it will bridge several joists.

216. Length of Flooring to be Removed. In taking up a length of flooring the first step is to determine how much to take up. It is always best, if possible, to remove the entire board. Where it can be done, it requires but little or no more time than sawing the board into choppy sections. It is seldom advisable

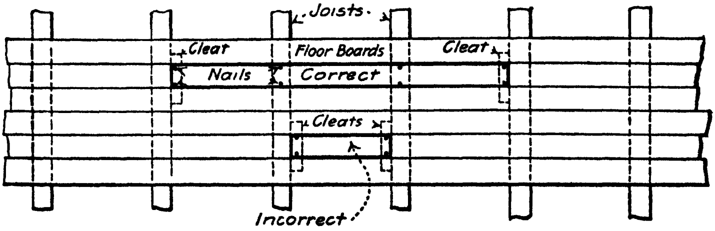


FIG. 105.—Showing how to make floor cuts.

to remove a piece as short as the distance between adjacent floor joists, after the manner indicated as "incorrect" in Fig. 105. The saw-cuts at the ends of such a short length are so close together as to be conspicuous, and the piece, after replacement, must depend for support on two cleats nailed to the joists, which may or may not provide a firm foundation. There is always a tendency to creak or rock. It is better, even for a small pocket, to make the saw-cuts so that a piece of flooring can be removed long enough to span at least three and preferably four joists, as indicated under "correct" in Fig. 105. The intermediate joists will effectively support the middle portion of the piece that has been removed and prevent creaking and rocking.

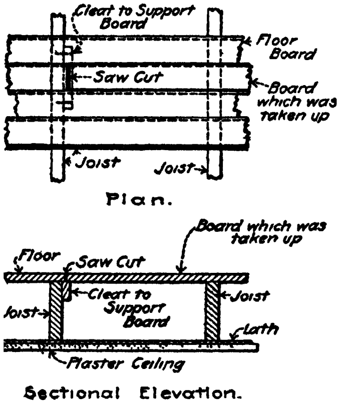
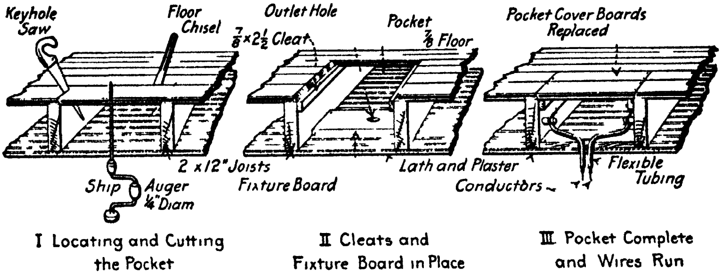


FIG. 106.—Cleat to support floor boards.

217. Cleats to Support Replaced Floor Boards. Before replacing boards removed from a soft-wood floor cleats are nailed to the joists at the ends of the pocket, as shown in Fig. 106, to support the floor-board ends. Each cleat is possibly 4-in. longer than the width of the pocket and is pushed up snugly against the edges of the boards at the sides of the pocket before being nailed to the joist. Two finishing nails, one near each edge, should be driven through each floor board at each joist. The use of two nails in each joist prevents rocking and creaking if the board happens to be twisted or warped. Where there is any possibility of its being necessary to again remove the floor boards after they are replaced, screws should be used for holding them down rather than nails.

217a. The operations in cutting a small pocket, that is, one the cover boards of which extend only between two adjacent joists, are shown in Fig. 106*A*. As suggested in another paragraph, it is always preferable to so cut a pocket that its cover boards will bridge at least three joists. Nevertheless, pockets are frequently made as shown in Fig. 106*A*. At *I* is shown the small exploring bit which has been bored up through the ceiling to locate the pocket. Although a 1/4-in. diameter bit is shown in the illustration, a much smaller one (see Par. **246**) should be used where possible. After the pocket location has been determined the floor boards are sawed across. Some wiremen slant the saw as shown, maintaining that when it is guided thus the slot left by it is not as conspicuous as when the saw blade makes a vertical cut. (See Par. **218.**) After the cover boards are out of the way the cleats are nailed to the joists and the fixture board, into which the supporting screws of the fixture that is to hang in the room below are to turn, is nailed in place as shown at *II*. In *III* the completed pocket with the wiring in place is illustrated.



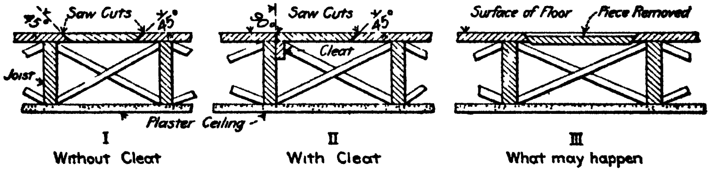
I Locating and Cutting the Pocket

II Cleats and Fixture Board in Place

III Pocket Complete and Wires Run

FIG 106*A* —Successive operations in making a small pocket.

218. A quick method of cutting a small pocket is shown in Fig. 107. It is not a good method and should not be used except in very cheap work where appearance is of no consequence. The pocket can be made without a cleat, as shown at *I*, by making two saw-cuts, at an angle of 45 degrees with the surface of the floor, across one or two floor boards. When the pieces of board that were removed to form the pocket are replaced they will be sup-



I Without Cleat

II With Cleat

III What may happen

FIG 107 —Quick methods of cutting a pocket

ported by the 45-degree extensions on the boards that were not taken up. The pieces that were removed can be nailed in place. However, these pieces will drop a little below the surface of the balance of the floor, as shown at *III*, because of the wood cut out by the saw. This is the undesirable feature of the method. This defect can be corrected, as shown at *II*, by making one saw-cut at 90 degrees along the side of a joist and making the other cut at 45 degrees. A cleat is nailed to the joist to support one end of the piece. The piece is butted against the 45-degree projection leaving a small crack at the 90-degree saw-cut. It is then nailed in place.

REMOVAL AND REPLACEMENT OF TRIM

219. To avoid splitting the timber when driving a nail near the edge of a board, cut off the point of the nail with side-cutting pliers. Such a nail will punch rather than wedge its way through. It may be driven almost on the edge of the board or trim without splitting it.

220. Inexpensive tools for removing baseboards (Fig. 108) can be made of an old blacksmith's rasp or of a discarded buggy-spring. That shown is made by untempering a rasp, flattening the file points and drawing each end to a sharp edge. Two inches from one end the rasp should then be bent at right angles. A 1-in. offset in the middle completes the tool. The whole should measure about 14 in. in length. A similar tool can be made of a heavy buggy-spring by merely drawing out the small end and finishing it to a chisel point. A blacksmith can make either of these tools for 25 cents.

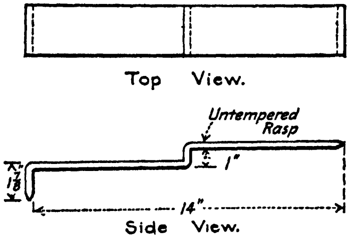


FIG. 108.—Tool for removing baseboards.

221. Punch the nails through when removing trim. If an effort is made to remove the trim by pulling the nails out the probabilities are that the wood will be split and that the trim will be damaged. When the nails are punched through with a fine nail set prior to the removal of the trim the difficulties outlined above will not be encountered. When trim is removed with the nails in, it is always advisable to cut them off as shown in Fig. 109 instead of driving them through.

222. Removing Nails from Trim. Before replacing finished trim the nails left in it should be cut off flush with the back of the trim, with a pair of pliers or a cold chisel (Fig. 109), or should be broken off with a hammer. If an attempt is made to drive them out, they will almost invariably chip out slivers of the trim, as indicated in Fig. 110. New finishing nails of small diameter should be used for refastening the trim. See also Par. **219** regarding nails for fastening trim.

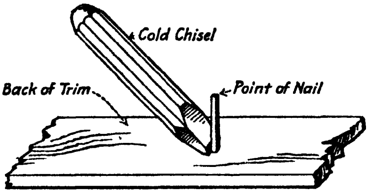


FIG. 109.—Cutting off nail with cold chisel.

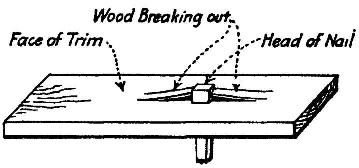


FIG. 110.—Sliver split out of trim by driving out nail.

CUTTING OUTLET HOLES

223. Cutting Outlet Holes in Plastered Surfaces. Before cutting a large hole for an outlet box, switch, or fixture, the wireman should always assure himself that the wires can be brought to the outlet. He should first prepare the wire route to the outlet location and then cut the hole. Sometimes it is necessary to bore a small "exploring hole" through which a mouse can be inserted, at the point where the outlet is desired, before the outlet hole is cut. The mouse can be dropped down within the partition to ascertain if the contemplated route is clear of obstructions. This done, the wireman should locate the laths in the vicinity by probing with an awl or a very fine finishing nail. He can then so cut the hole that the screws supporting the outlet or switch box, plate or fixture will each engage a lath, and so that the hole through the surface will be no larger than necessary.

224. Cutting Holes for Switch Boxes in Plastered Surfaces. The face plates of switches are only 1/4 in. to 3/8 in. larger than the hole that must be cut for the box. Very careful work is necessary, therefore, to insure that, after the job is completed, the hole will not show at the top or sides of the face plate. Using a small screw-driver or an awl as a feeler, the wireman should first locate an opening between two laths. A hole of the proper size for the switch should then be cut in the plaster with the point of a screw-driver. The hole must be so cut in relation to the laths that the screws that support the box will engage the laths. A keyhole saw should be employed to cut out the laths. Before the sawing is begun the workman should probe in between the laths with his screw-driver or a probing tool to be sure there are no pipes or other obstructions to interfere with the work.

225. Cutting Holes for Round Outlet Boxes in Plastered Surfaces. First, probe through the plaster to locate the laths as suggested in the preceding paragraphs. Then outline the space to be cut by placing the outlet box against the surface and drawing a line around its circumference. Instead of using a pencil the line can be drawn with a sharp-pointed tool or with the edge of a small piece of tin. The box should be so located, when the line is drawn, that it lies in correct relation to the laths. Now carefully cut away the plaster within this space with a wood chisel. The recess should allow an outlet box, having a standard depth of 7/8 in., to rest against the lath. The lath crossing the center of the outlet hole should be cut away the full width of the hole to provide for the admission of the conductors. The outlet box is shown in Fig. 44.

226. When sawing out a lath at an outlet hole it is best not to saw entirely across the lath at once. The lath may terminate on an adjacent stud, in which case if it is attempted to make the second saw-cut, the first one having been made, entirely across the lath, it is probable that the short length of lath will break out the plaster. Each cut should be made about two-thirds of the way through the lath and then each of the two cuts should be sawed alternately—a little at a time—until the lath is severed at both cuts.

BORING AND BORING TOOLS

227. Boring Plaster of Paris Canopies and Molding. It is frequently necessary to cut holes through these canopies, which are found in the older houses, for the accommodation of loom. A Syracuse twist drill is the best tool for the purpose. It may be used in a bit brace and will quickly cut a smooth round hole. Such a hole should be bored upwardly into the ceiling. If it is bored from the interior of the ceiling downwardly, plaster will probably chip off around the hole. The drill should be very sharp and little pressure should be used in its operation. Where a rounded surface is to be bored into, a flat area should first be cut with a knife to provide a starting place.

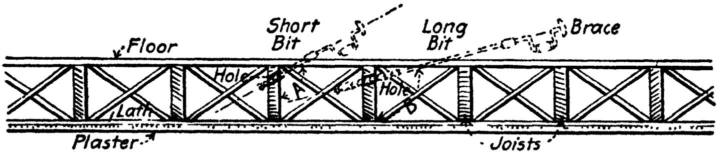


FIG. 111.—Boring holes in joints.

228. In boring holes in joists after floor boards have been removed it is a good plan to use a bit with a long shank or bit extension. Where this is done the tubes that are inserted in the holes to insulate the wires will lie more nearly parallel to the surface of the floor, the conductors will draw through them more easily, and abrasion of the insulation on the wires will be minimized. Fig. 111 illustrates this. Where a short bit is used as at *A* the hole lies at a considerable angle with the floor, while at *B*, where a long bit is used, the hole is more nearly parallel with the floor. Instead of using a long bit, a short bit in an extension like that of Fig. 112 can be utilized.

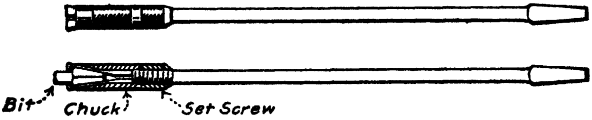


FIG. 112.—Extension bit holder.

229. A tool useful in boring holes from outlets and pockets for risers in closed or blocked partitions and handy for other purposes is illustrated in Fig. 113. It is made of a door knob and a 5/8-in. Irwin bit. The shank is cut off the bit and fitted into the stem of the door knob. A hole is then drilled through the shank of the bit as illustrated and a nail inserted and headed over to prevent the bit from turning. It is a good plan to fill the knob with solder.

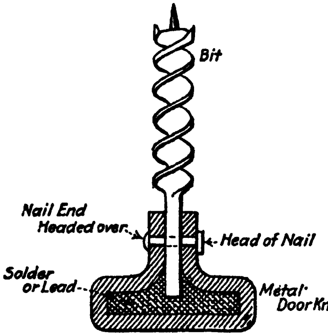


FIG. 113.—Tool for boring in outlets and pockets.

229a. Ratchet Drills for Boring Floor and Ceiling Plates. An application of the ratchet drill is shown in Fig. 113*A* where a hole is being bored for a conductor way from a pocket up through a floor plate into a partition. The drill is similar to that used by steel workers and track men for drilling metal. For finished-building wiring the smallest, lightest tool obtainable will be satisfactory. The bit is placed in the chuck of the tool and the feed-screw end rests against a floor plate, if one is available, or against a long board lying, parallel to the joists, on the laths. If the board is long the pressure due to the drill will be distributed over a considerable area and no damage to the ceiling

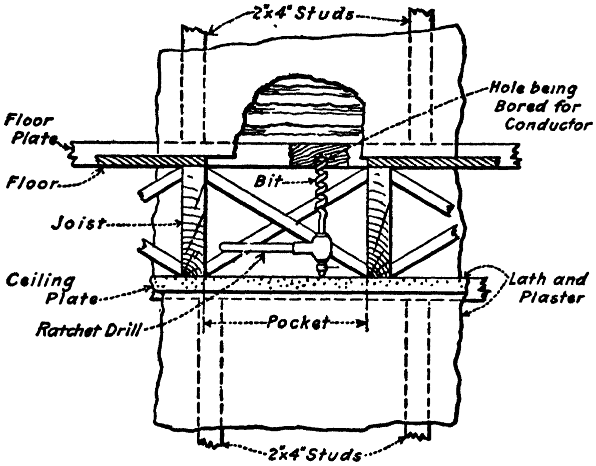


FIG. 113*A*.—Application of the ratchet drill for boring a floor plate.

will result. Furthermore, the screw at the end of the bit assists in feeding it so that relatively little pressure from the feed screw of the ratchet drill is necessary. A hole can be bored in a very contracted space with the ratchet drill. Fig. 113*B* shows two commercial forms of the tool.

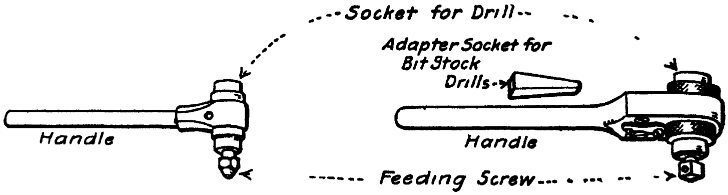


FIG 113*B*—Ratchet drills.

230. Construction and Application of the Pipe-extension Boring Tool. Where there are bridges or other obstructions within a partition and the top of the partition—the header—is accessible from an attic or from a pocket formed by removing floor boards, the method and tools illustrated in Figs. 114 and 115 can be used. The pipe-extension boring tool consists of a (Fig. 115) length of conduit, threaded on one end, into which a bit extension has been secured or to which a chuck that will accommodate an ordinary bit brace has been fastened by some means. Several lengths of conduit, threaded on both ends and fitted with couplings, should be provided. The lengths of these extension pieces are determined by the conditions under which they are to be used. Where they will be used in a space having little head room they must be short. Where there is ample

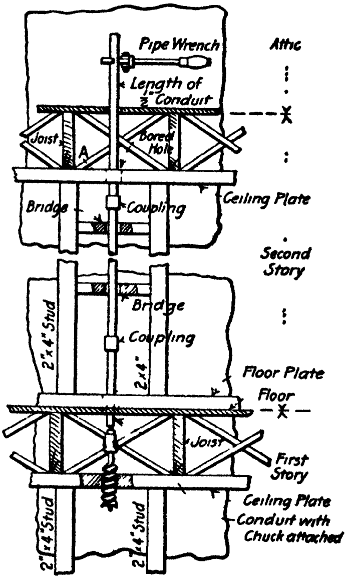
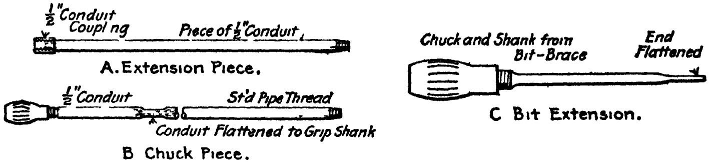


FIG. 114.—Illustrating use of pipe-extension boring tool.

head room they can be long. Probably 4 ft. is a fair length for both the chuck-piece and the extension pieces.

One method of securing a bit extension into the conduit is shown in Fig. 115. The shank of the extension is flattened as at *A* and then inserted in the conduit which in turn is flattened as in *B*. Bit extensions (Fig. 112) can be purchased at hardware stores, but they can be made by straightening out the bent portion of an old brace and flattening its end.



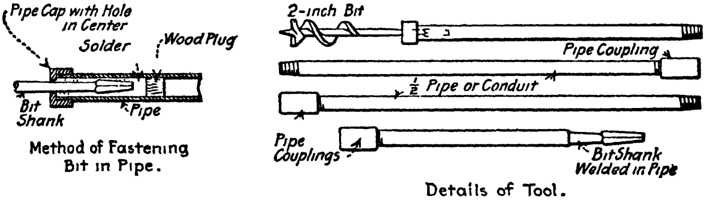
A. Extension Piece.

B Chuck Piece.

C Bit Extension.

FIG. 115.—Chuck end of pipe-extension boring tool and detail of bit extension.

231. Another type of pipe-extension boring tool is illustrated in Fig. 116. It differs from that just described only as to the method whereby the bit is fastened into one of the pipe sections. With the tool of Fig. 115 a bit of any diameter can be fastened in the chuck. With the arrangement of Fig. 116 a bit of a certain size is fastened in a pipe section and there must be such a pipe section, equipped with its own bit, for each diameter of hole that is to be bored.



Method of Fastening Bit in Pipe.

Details of Tool.

FIG 116.—Another type of pipe-extension boring tool.

232. A pipe-extension boring tool for boring through joists under a floor is shown in Fig. 117. It is a modification of the boring tool described in preceding paragraphs and is constructed thus: A 1-in. or 1 1/4-in. auger bit is welded in the end of a short length of conduit the farther end of which is threaded. The tool is extended to the desired length by other sections of conduit, each from 8 to 10 in. long, threaded at both ends, and connected with one another by a standard coupling. When a more convenient method is not available, the tool may be turned with a pipe wrench.

233. A dowel joint for the pipe-extension boring tool, often preferable to the conduit coupling joint, is described by Fig. 118. A dowel of 1/4-in. pipe is riveted at one end into the 3/8-in. pipe used for the tool. The other end of the dowel is fastened into another section of the tool with a flat-headed machine screw. The hole for the screw is tapped through one wall of the pipe or conduit and unthreaded through the other wall. This method has a twofold advantage over the use of iron-pipe couplings. *First,* it provides no possibility of the pipe lengths being twisted apart regardless of the direction in which the brace of the boring tool is turned. *Secondly,* the external diameter of the joint or coupling is practically equal to that of the pipes it connects.

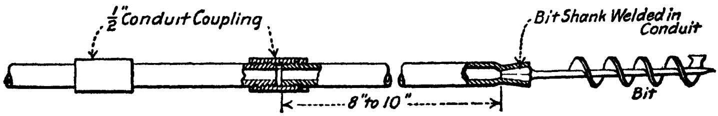


FIG. 117.—Another type of pipe-extension boring tool.

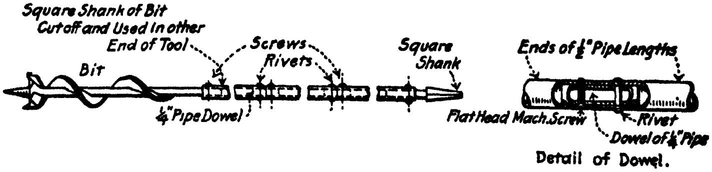


FIG. 118.—Dowel joint for pipe-extension boring tool.

234. Manipulation of the pipe-extension boring tool is illustrated in Fig. 114. The bit, usually 1 1/2 in. or 2 in. in diameter, is clamped in the jaws of the chuck-piece and is started into the header *A* by twisting the chuck-piece by hand. As soon as the bit commences to "bite" the conduit should be gripped with a pipe wrench—or a bit brace can be used if the pipe-extension tool is equipped with a bit brace chuck. The tool is then turned with the wrench until the bit cuts through the header. Next it is dropped vertically downward through the hole until the bit engages a bridge or other obstruction within the partition. If necessary to make the tool longer to reach the obstruction, an extension piece of conduit is screwed to the end of the chuck-piece. The bit is then turned with the pipe wrench or bit brace through this obstruction and when it is through is dropped to the next one, an extension piece of conduit being added if necessary. This process is repeated until an unobstructed vertical runway is provided for the required distance. Wiremen have bored runways with this tool through the obstructions in the partitions of three stories. The upper hole was through a header exposed in the attic of a three-story house and the last hole was through the ceiling of the basement. Instead of using a pipe wrench for turning the tool, a carpenter's brace can be utilized, provided one extension section of conduit for the tool is equipped with a square bit shank as shown in Fig. 118.

235. In turning the pipe-extension boring tool with a pipe wrench a wireman and his helper stand facing each other and with the vertical conduit piece having the wrench on it between them. One man gives the tool a half turn by pulling the wrench around and then the other pulls it through the rest of the revolution. This is continued until the bit emerges from the cut. Both hands should be used in turning, one on the wrench handle and the other on the conduit to steady it. An ordinary bit brace can be used if the working space is not restricted.

236. Size of Holes to be Bored with Pipe-extension Boring Tool. It is always advisable to bore a 1 1/2-in. or 2-in. hole with the tool, because bits of these diameters feed more effectively than smaller ones. Furthermore, a relatively large hole is usually required to receive the several loom-covered conductors that are often installed as a single group within a partition. Four No. 14 wires, each encased in flexible tubing, can be carried through a 2-in. diameter hole.

237. An extension-bit holder, Fig. 112, is a very convenient tool for the finished-building wireman. It is used in a bit brace for boring holes in joists. The holder is 2 to 3 ft. long, and enables wiremen to bore holes in a recess, or in places where a long bit would be needed. By coupling two of the holders, the wireman can bore circuit holes in joist while standing, which renders the work much easier, where there are a number to be drilled.

237a. A home-made extension-bit holder can be constructed

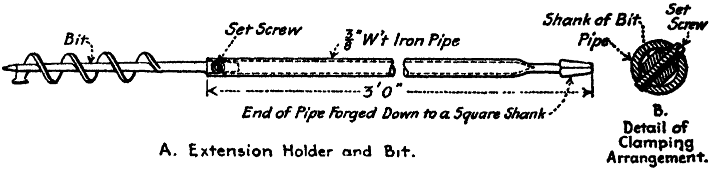

Bit
Set Screw
3/8" W't Iron Pipe
Shank of Bit
Set Screw
Pipe
3'0"
End of Pipe Forged Down to a Square Shank
A. Extension Holder and Bit.
B. Detail of Clamping Arrangement.

FIG. 118*A*.—Home-made extension-bit holder.

from a length of standard 3/8-in. wrought-iron pipe as shown in Fig. 118*A*. The end of the shank bit is fitted into the inside of the pipe. (Standard weight 3/8-in. pipe has an internal diameter of 0.493 or approximately 1/2 in. and an external diameter of 0.675 or approximately 43/64 in.) The shank of the ordinary bit makes a fairly good fit in the end of the pipe. A hole, possibly 1/4 in. in diameter, is then bored through the pipe and the bit. Then the bit is removed and the hole in it is tapped for a standard machine screw. The holes in the sides of the pipe are reamed out with an old file so that the machine screw will pass through them. The other end of the pipe is forged down solid and into a square shank so that the chuck of an ordinary bit brace will engage it. In use, the bit is placed in the pipe and machine screw is inserted to prevent the bit from turning. An extension thus constructed from 3/8-in. pipe is often preferable to the commercial extension of Fig. 112, because the pipe will pass through a smaller hole than will the chuck (which is usually about 7/8 in. in diam-

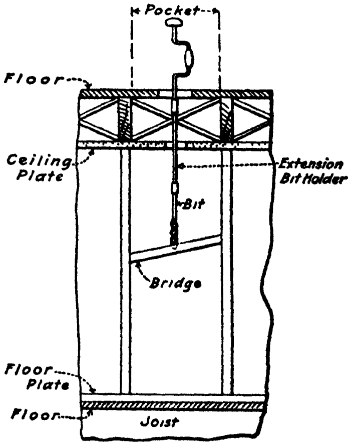
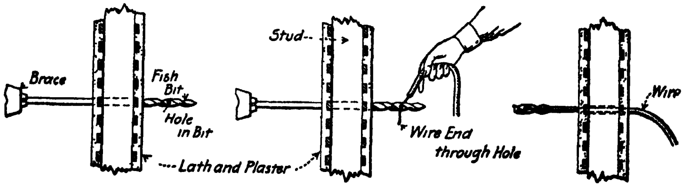


FIG. 118*B*.—Boring through bridging with a home-made extension-bit holder. (Illustration shows interior of a partition, the lath and plaster of one side having been removed, exposing the lath and plaster of the other side.)

eter) of the commercial product. Fig. 118*B* shows an application of the tool.

238. The necessity of fishing wires through the holes bored by the pipe-extension boring tool can be avoided where it is possible for the wireman's helper to reach the point of the bit after it has penetrated the obstruction. Where the point can be reached, a pulling-in line should be attached to the bit before the hole is bored by tying it above the spiral formation at the tip of the bit. The cord should be wound around the bit imbedded in the spiral groove in such a way that it will not be severed during the manipulation of the tool. When the screw point of the bit becomes accessible to the helper below he should detach the line and hold it while the wireman above withdraws the boring tool. The conductors may be attached to this line and drawn to the desired outlet.

239. The steel fish bit (Fig. 119) is a useful tool. The bit has a hole in its end. After the bit has been bored through an orifice, the wire to be drawn through is made up through the hole and the wire and bit are together drawn back through the orifice. The use of a snake is thereby eliminated. In a floor or ceiling, the orifice having been bored, it may be more convenient to first withdraw the bit and then to thread the wire through the hole at the end of the bit, and to push the bit back through the hole. Good bits of this type are so tempered that they will drill through wood, masonry, wrought iron or structural steel.



Bit through Stud

Wire in Bit Hole.

Wire Being Drawn through.

FIG. 119.—The steel fish bit and its application.

EXPLORING LAMPS AND DEVICES AND THEIR APPLICATION

240. Illumination and Exploring of Partition Interiors while Fishing. A miniature incandescent lamp can be used. A pair of dry batteries bound together by tape (Fig. 120), a lamp small enough to pass through an 11/16-in. hole, and about 20 ft. of flexible conductor (preferably duplex) complete the outfit. Such a lamp when dropped into the interior of a partition is safer and far more convenient than the lighted candle, sometimes used. Not only are exploring lamps useful when fishing but they are effectively utilized when boring holes through remote obstructions. The lamp can be lowered into a partition through a bored hole and will illuminate the entire space.

241. Home-made exploring lamps are shown in Fig. 121. The device at *A* is a tubular incandescent lamp soldered to the end of a length of flexible cord, while the one at *B* is merely a candle attached to a length of copper wire. Obviously the form shown at *A* is useful only in houses where a source of electrical energy is available. Candles should not be used except in cases of emergency because they have been known to start fires in partition interiors. Electric lamps are much preferable from every standpoint.

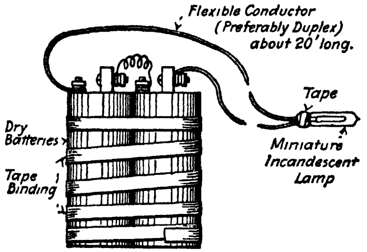

Flexible Conductor (Preferably Duplex) about 20' long.
Tape
Dry Batteries
Tape Binding
Miniature Incandescent Lamp

FIG. 120.—Battery and lamp set for illuminating partition interiors.

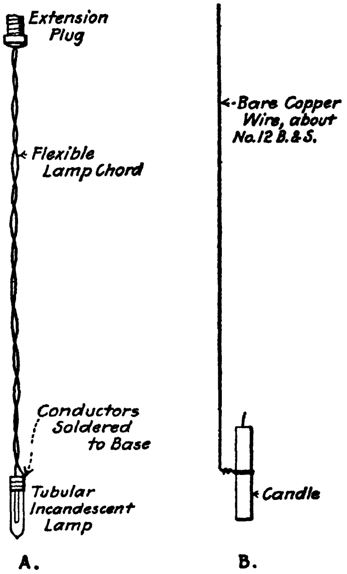

Extension Plug
Flexible Lamp Chord
Conductors Soldered to Base
Tubular Incandescent Lamp
A.
Bare Copper Wire, about No.12 B.&S.
Candle
B.

FIG. 121.—Exploring lamps.

242. An application of an exploring lamp in fishing is shown in Fig. 122. It shows how a drawing-in line can be pulled from the basement of a one-story frame building to the attic. A slanting hole *A* is bored from the basement, through the floor and plate into the space within the outer wall. A soft-iron or copper wire having a loop formed in its end is then pushed through the hole and into the space. A strong cord—heavy linen fish-line is the best—which has a hook bent from stiff iron wire tied to its lower end is let down from the attic into the space. An exploring lamp fed either by dry batteries or from an extension lamp socket is also let down into the space. This lamp will provide illumination whereby the hook can be engaged in the loop. After the engagement is effected the circular-loom-encased or metallic flexible conductors can be drawn from the basement to the attic.

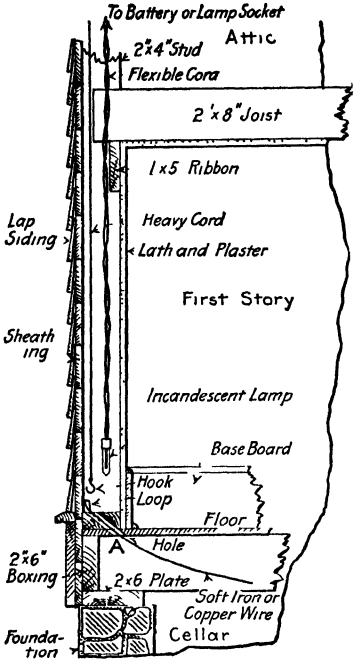


FIG. 122—Exploring lamp used to facilitate fishing

243. Methods of exploring wiring spaces under floors, involving the use of a mirror and a light source, are illustrated in Figs.

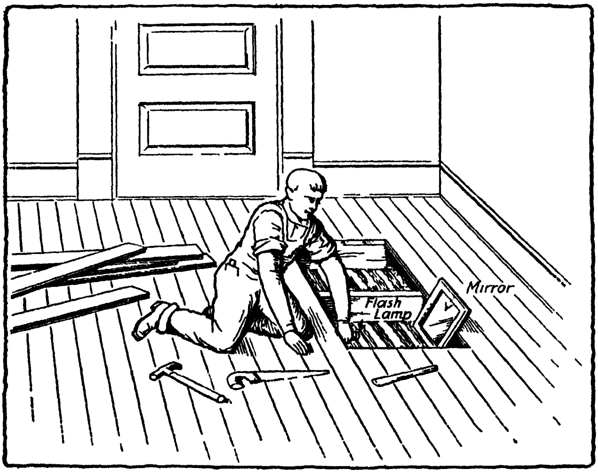


FIG. 123.—Exploring wiring space with flash lamp and mirror.

123 and 124. The source of light can be arranged in one pocket and the mirror at the other or both mirror and light source may be used in the same pocket. Where both are used at the same pocket, as in Fig. 123, the light must be quite strong and a flash lamp or an electric lamp with a reflector behind it is usually necessary. Where the light is in one pocket and the mirror at another a candle will give fairly good results, provided the distance between pockets is not too great, but an electric lamp on an extension cord is better. Where the pockets are sufficiently large that the wireman can get his head into one of them there is no necessity for the mirror. A large pocket is shown in Fig. 123 merely to provide room to permit of an understandable illustration. Where the outlet hole in a partition is sufficiently large to permit of the insertion of a mirror, obvious modifications of the above methods can be used for exploring partitions.

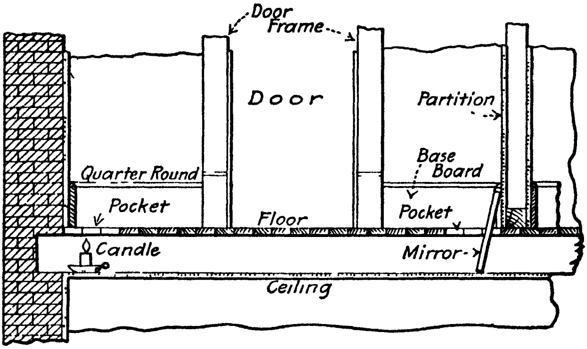


FIG. 124.—Exploring wiring space with candle and mirror.

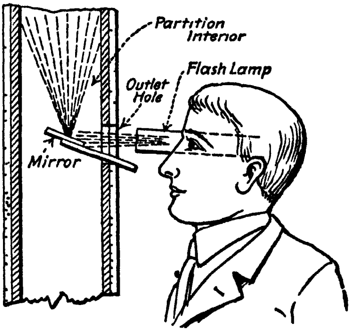


FIG. 125.—Examining partition interior.

244. Exploring Partition Interiors. With a pocket flash lamp and a small mirror the interior of a wall or partition which would, ordinarily, be inaccessible can be inspected (Fig. 125).

The mirror is introduced in the outlet hole and the flash lamp and eye are held behind it as illustrated. The mirror reflects the light of the lamp onto the place to be illuminated, at the same time reflecting the image back to the eye.

245. Electric Exploring Lamps. The lamps should be small so that they may readily be inserted through holes or pockets. A 1 1/2-volt battery lamp that will operate from two or three dry cells is shown in Fig. 126 at *C*. It requires 0.45 watt, provides a horizontal candlepower of 0.51 and costs about 25 or 30 cents. A 110-volt (the lamps are made for any voltage between 100 and 130) "Candelabra" lamp is shown at *B*. It takes about 25 watts, provides about 7 horizontal candle power and costs 25 or 30 cents. Porcelain weather-proof sockets, *A*, can be purchased for about 10 or 15 cents to accommodate either the candelabra or the miniature lamp bases. The sockets are regularly furnished with 6 in. of No. 18 B. & S. stranded, rubber-insulated wire to which flexible cord of any desired length can be soldered.

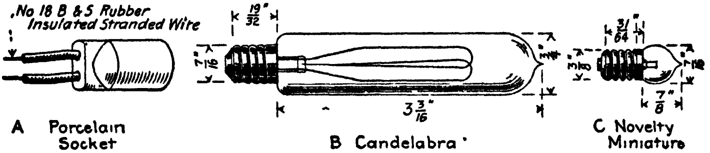


FIG. 126.—Incandescent lamps for exploring

246. An effective exploring bit is illustrated in Fig. 127. The tool will bore a fine hole through floor, wall or partition and is especially useful in locating a larger hole to be drilled from the reverse side of an obstruction. The bit is a piece of steel wire 6 to 8 in. long. One end is filed to a drill point similar to that of a brad-awl. At the other end enough wire should be bent back and forth to form a shank which will be held in the chuck of a bit brace. Umbrella ribs or coppered steel wire will serve the purpose. The bit will cut rapidly and, if sufficiently thin wire is used, the holes left by it will be almost invisible. The cutting point of the bit

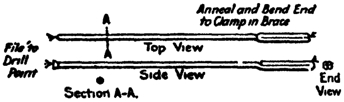


FIG. 127.—Exploring bit.

should be flared as shown in the lower drawing of the illustration so that the bit will clear itself.

247. A simple, magnetic locator for finished-house wiring comprises a pocket compass and a large, magnetized file. Fig. 128 illustrates how the contrivance locates the point at which to bore a hole through a floor and the ceiling underneath. The file should be strongly magnetized. It is then driven into the ceiling at the point where it is desired to drill the hole. By moving the compass over the floor above, the location of this point will be obvious. The compass needle is violently agitated when moved directly over the file.

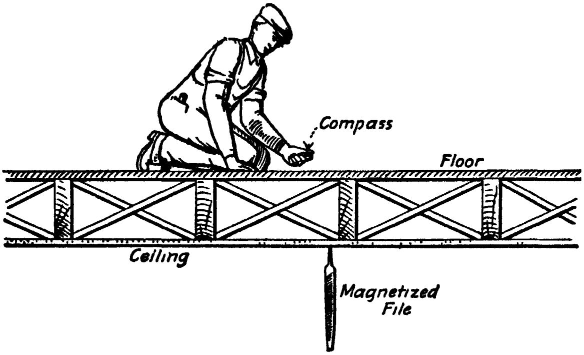


FIG. 128.—Magnetic locator.

FISHING AND FISHING DEVICES

247a. Animals as Assistants in Fishing. In certain cases where other methods were not feasible, small animals have been used to draw pulling-in lines through wireways. Trained weasels have been used in threading underground conduit subways. In finished-building wiring, a cat can often be made to draw a cord through a raceway between floor and ceiling that is so obstructed by braces and bridges that it cannot be readily fished by the ordinary means. A length of cord is tied to a harness on the cat or to the animals tail. The cat is then placed in one end of the wireway and that end darkened. The far end of the wireway is illuminated—with a candle if necessary. The cat will usually walk toward and out of the illuminated end of the wireway bringing the pulling-in cord with her.

248. The mouse is a tool used for probing and sounding vertically within walls or partitions. It consists essentially of a small weight tied to the end of a, preferably very strong, cord. It is used for detecting cross-pieces, bridges, braces and other obstructions and for locating clear wireways. The modifications of the elementary form are numerous. Two "home-made" types of mice are shown in Fig. 129.

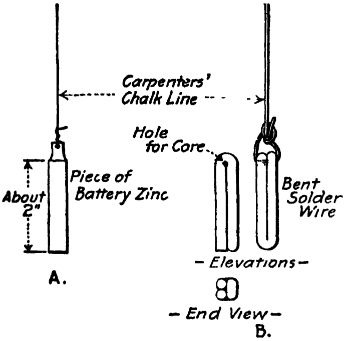


FIG. 129.—Showing the construction of a " mouse."

249. A simple mouse may be made of a waxed shoemaker's string and a piece of solder about 4 in. long. The solder should be bent in the middle and the string tied to the arch. Four loop knots should be tied in the string just above the solder. The weight of the solder will readily carry the string down within a partition, and the loop knots will afford a means of engaging the string at the outlet with a fishing hook.

250. A weight-and-chain mouse can be made of a lead sinker, a small brass spring, a bead chain, a wire ring, and a length of cord as shown in Fig. 130. This tool will find its way readily in a partition or wall, serving as a feeler both in going down and coming up. A common fishing sinker not more than 3/8 in. in diameter may be used. One end of the brass-wire spring should be looped into the hole of the sinker and the other end soldered to the bead chain. A small ring should connect the string and chain.

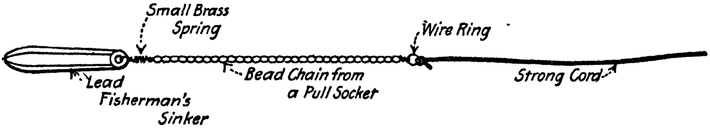


FIG. 130.—Mouse with chain inserted.

251. A lead pellet mouse is advocated by some finished-building wiremen. It is constructed as shown in Fig. 131. The pellets are made from strips of sheet lead about 3/4 in. long and 1/4 in. wide. They are rolled around the fishing cord and hammered tight thereon. There should be a space between pellets of possibly 3/16 in. and there should be eight or ten pellets on the cord. The series of little lead cylinders furnishes a considerable weight on the end of the cord so the mouse will drop down readily through irregular holes and the spacing of the weights insures flexibility. If the weights show a tendency to slip on the cord and pack together a knot can be tied in the cord between each weight and its neighbor.

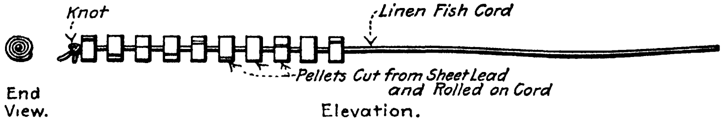


FIG. 131.—The lead pellet mouse.

252. Chain for Fishing. Chain (Fig. 132) of the sort used by plumbers, for attaching the plugs of lavatories to the loop, is frequently very useful for fishing. It is heavy, hence will drop through a raceway readily and the holes in the links provide places where the hooked ends of fishing wires can engage. Sometimes the wireman carries a long length—25 ft. or so—for use in partitions and for pulling wires through flexible conduit for which the chain is very useful. In other cases a short length—possibly 18 in.—is tied on the end of a linen fish-line (Fig. 132) to provide weight and a medium whereby a fishing wire can be engaged. Some wiremen prefer the chain weight on the end of a fish-line to the lead weight of Fig. 130.

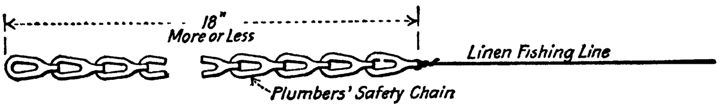


FIG. 132.—Fishing line with chain attached.

253. Pull-socket Chain for Fishing. Some wiremen prefer a socket-chain fish-line to one of any other material. A short length of socket chain used in a mouse is shown in Fig. 130. It is somewhat better in one respect, though more expensive, than *plumber's chain, shown in Fig. 132,* because the socket chain will glide readily over obstructions that might foul a plumber's chain. However, the bead chain has no open holes, like those in plumber's chain, wherein a fishing hook may be engaged. The chain can be purchased in any length desired from the large electrical supply houses.

254. A snake or fishing wire is a piece of wire, usually quite stiff and springy, used for fishing in partitions but more particularly within floors. Galvanized iron or steel wire of round cross-section is sometimes used, but special steel wire of rectangular cross-section is the most desirable material. This rectangular section fish-wire, like that listed in Table **255** and shown in Fig. 133, can be purchased at electrical supply houses or at corset factories. The business end of a snake should always be bent into the form of a hook as shown in Fig. 134 to prevent its catching on plaster or on small projections as it is pushed forward. It is also frequently desirable to tie a loop of cord in the hook or to wind iron wire around the end as shown to provide places where probing hooks or hooks on other fishing lines can engage.

255. Dimensions of Steel Fish-wire. The 1/4 in. wide wire is most frequently used. The wire is usually put up in coils of 50, 75, 100, 150 and 200 ft.

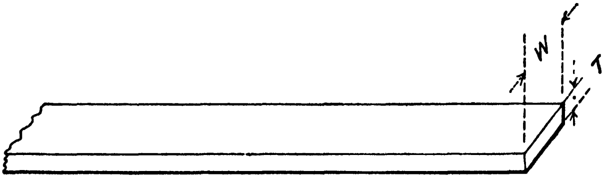
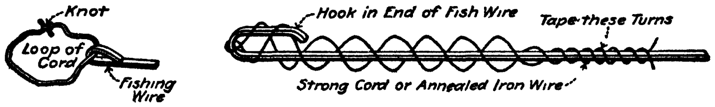


FIG. 133.—Steel fishing wire.

W Width, inches	*T* Thickness, inches	Weight, per 100 ft.	Approximate price, cents	
			Per pound	Per foot
1/8	0.015	11 oz.	90.0	0.62
1/8	0.030	1 lb. 4 oz	60.0	0.75
3/16	0.030	1 lb. 14 oz.	60.0	1.13
1/4	0.030	2 lb. 8 ox.	60.0	1.50
5/16	0.035	3 lb. 8 oz.	55.0	1.93
3/8	0.035	3 lb. 12 oz.	55.0	2.06

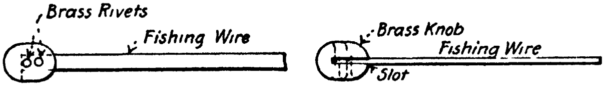
256. A knob should be fixed on the end of a snake for fishing conduit as shown in Fig. 135. Such a device is almost necessary for flexible conduit and is desirable for long runs of rigid conduit. If flexible conduit is fished with a snake having only a hook at its end, the hook sometimes catches in the joints between convolutions of the conduit, which separate when the duct is bent, rendering withdrawal difficult.



A. Cord Loop. B. Iron Wire Winding.

FIG. 134.—Method of preparing end of snake or fishing wire.

257. The Helper's Work in Wire Fishing. Two men usually are necessary to fish conductors through partitions and spaces between a ceiling and the floor above. One man is required to push the fish-wire through the wireway and the helper should be stationed at the outlet to catch the fish-wire as soon as it comes sufficiently near the opening. The helper should have another length of fish-wire with a hooked end, or a fishing hook (Fig. 139), which he can insert through the outlet to engage the main fish-wire being manipulated by the wireman. The main fish-wire will disclose its location by the noise it makes in scraping along the plastered interior of the partition or along the woodwork within a floor.



Plan. Elevation.

FIG. 135.—Knob on end of snake for fishing flexible conduit.

258. A snake or fishing wire with a weighted end is illustrated in Fig. 136. It is made by weighting the end of the steel tape with a piece of solder. The solder may be put on while molten and allowed to cool or may be fastened with a piece of binding wire. If melted solder is cast on to form the weight, the fishing wire must previously be filed bright and clean and sal ammoniac should be used for a flux. It will keep the snakehead down and prevent it from coiling up in the floor bays so that it can easily be pushed from pocket to pocket along the laths. The end is bent into the form of a hook to which the conductors may be attached when the snakehead reaches an outlet. By pulling back the "snake" the conductors are drawn to the point desired.

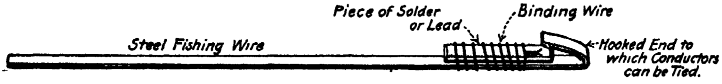


FIG. 136.—Weighted fish-wire.

259. Use of a Steel Measuring Tape as a Snake. It is utilized by winding it up tight like a clock spring and then releasing the coil after it has been placed on edge in the space between a floor and ceiling. If started correctly the tape will uncoil in the direction of the outlet at which it is aimed. It can be projected over open partitions into which an ordinary snake would have a tendency to drop.

260. The sectional steel rod sometimes used instead of a snake or mouse is illustrated in Fig. 137. The application of this tool eliminates the difficulty often encountered in fishing wires in walls and partitions when the upper and lower holes through plates are not vertically in line. The tool, which can be extended to any length, is made of rods of cold-rolled steel, 12 in. long, with an approximate diameter of 3/16 in. Each section of the rod, except one having the eye for attaching wire, is threaded at both ends. The sections are connected by short couplings. It is advisable always to have a coupling screwed on one end of each section. Enough sections should be carried in the tool kit to make up a rod 15 ft. long, more or less.

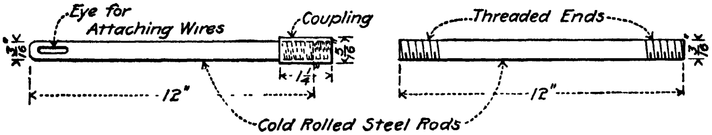


FIG. 137.—Sectional steel rod for fishing.

261. A rattan snake can be constructed as suggested by Fig. 138. A hook of steel wire is made up at the end of a length of rattan or reed such as used for weaving furniture. The reed may be 8 to 12 ft. long and, because of its tendency always to lay straight, can be used in many cases where no other sort of fishing device is satisfactory.

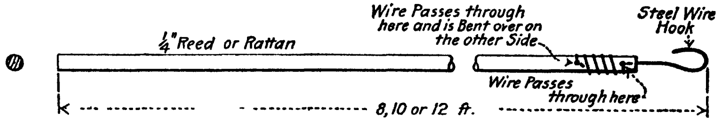


FIG. 138.—Rattan snake.

262. A steel-hook fishing tool can be made by brazing the steel end cut from a common shoe-button hook to a piece of No. 8 galvanized iron wire about 2 ft. in length as illustrated in Fig. 139. This wire is stiff enough to permit its being guided easily in any direction and flexible enough to be bent to any contour necessary. There is no danger of the hook being straightened by a heavy strain—a difficulty often encountered with the usual copper-wire hook.

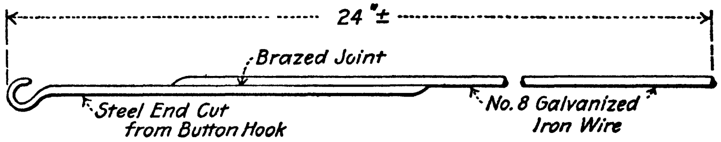


FIG. 139.—Steel-hook fishing tool.

263. A magnetized hook for fishing has been successfully applied in certain instances. A length of steel wire, which really constitutes a probe, has a hook bent in its end, is tempered hard and then magnetized. Some small iron wire is attached (in loops so that the hook can readily engage) to the weight of a mouse. When the mouse thus arranged is dropped down a raceway the magnetized probe can be inserted from the outlet hole or pocket. The hook will attract the iron wire and when they come in contact the wireman can "feel" it. He can then engage the wire with the hook and pull out the mouse and fish-line.

264. A sash-cord pulling-in line, particularly valuable for the installation of flexible steel conduit and flexible steel armored conductor, is shown in Fig. 140. A length of strong iron wire, twisted around the cord as illustrated, affords a means whereby the thing to be pulled in can be attached. The ends of the wire should be wrapped about the cord spirally in opposite directions so that when the wires are under tension they will grip the cord tightly.

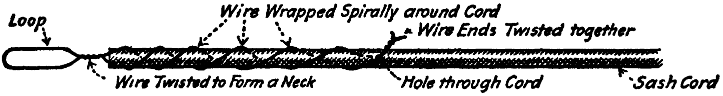

Loop
Wire Wrapped Spirally around Cord
Wire Ends Twisted together
Wire Twisted to Form a Neck
Hole through Cord
Sash Cord

FIG. 140.—Arrangement of sash cord pulling-in line.

265. The mouse and looped snake device, shown in Figs. 141 and 142, is a great time saver in the wiring of finished frame buildings. In these structures standard construction usually involves the use of 2-in. X 4-in. studs in the outside walls as shown in Fig. 141. A ribbon usually supports the floor joists for the second floor. This provides an unobstructed wireway from the attic to the cellar between the studs. Fig. 87 *II* gives the details of the usual construction. With the device being described, ad-

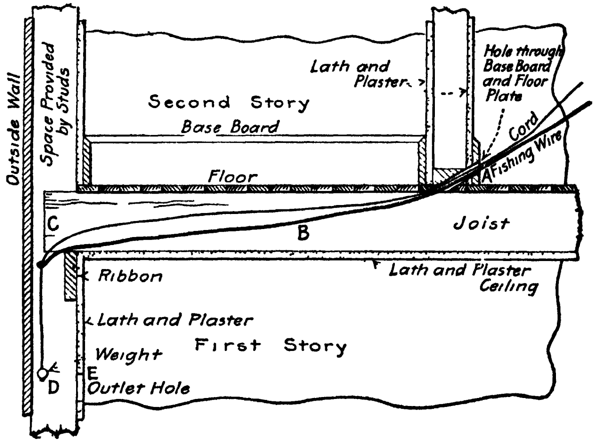


FIG. 141.—Application of mouse and looped snake device.

vantage may be taken of this clear space and conductors can be fished from a pocket at a partition on the second floor or from first-story electrolier outlet directly to the basement.

266. Construction of the Mouse and Looped Snake Device. This tool, shown in Fig. 142, comprises a steel snake and a mouse consisting of a length of cord and a lead ball about 1 1/4 in. in diameter or other similar spherical weight. A carpenter's chalk-line makes an ideal cord. A steel snake of rectangular section is best but one of round wire can be used. A loop, large enough so that the cord will pass through it readily, is bent in the end of the snake. The loop is bound with fine wire so that it cannot unbend. It is well to solder the binding. One end of the cord is then passed through the loop. The cord should be 20 or 30 ft. long. The cord is fastened to the spherical weight by passing it through a hole drilled in the weight and then tying a knot in it. Fig. 142 shows the details.

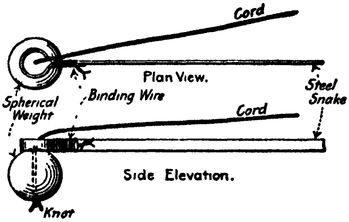


FIG. 142.—Details of the mouse and looped snake device.

267. Manipulation of the Mouse and Looped Snake Device. See Figs. 141 and 142. The end of the device comprising the weight and loop should be inserted through the outlet hole *A* into the space within the floor and pushed in the direction of the space *C* where it is proposed to drop the circuit. The cord is held taut as the wire is pushed along until the looped end reaches an open space *C*. The cord then is released and the lead weight drops. In houses of certain construction its path may be wholly unobstructed and the weight will drop from the second or third floor clear to the cellar. In such cases loom-covered or steel armored conductors can be drawn up to the outlet through which the weight and loop originally were pushed. When there is no free opening into the cellar, the wireman in the room above should pull the cord back and forth, thus causing the lead weight to bounce against the obstruction that prevents it from falling into the cellar. The helper standing in the cellar can locate the position of the obstruction by the sound of the weight striking the wood and can bore up through the brace or sill, making a hole through which the chalk-line can be drawn.

In pushing the weight and loop through the space *B* between the floor and ceiling, the wireman should continually twist and shake the appliance so that the weight may pass over obstructions in its horizontal path. He should be careful to select a space, *D*, between two studs not obstructed by an outside door or window through which to make the drop to the cellar.

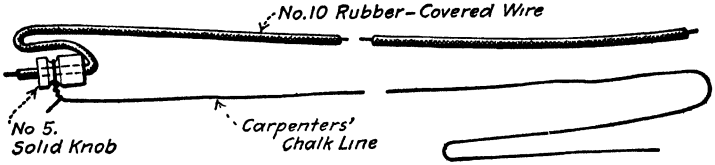


FIG. 143.—Substitute for the mouse and looped snake device.

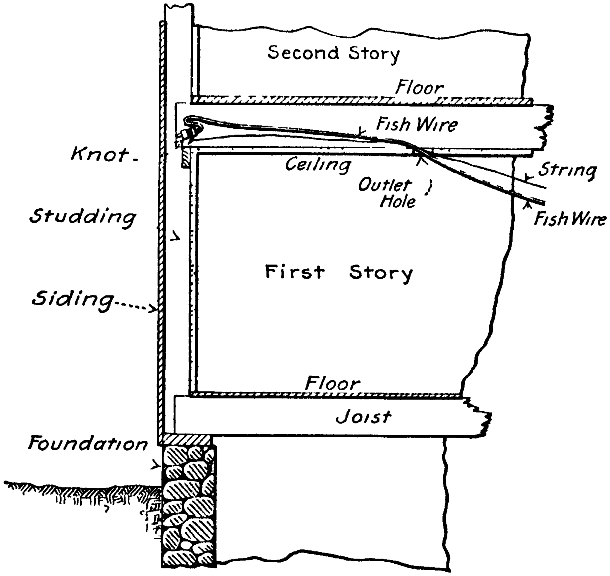


FIG. 144.—Application of the tool shown in preceding figure.

268. An emergency substitute for the mouse and looped snake device, which can be constructed from materials in any wireman's kit, is illustrated in Fig. 143, and its application is illustrated in Fig 144. Instead of the steel snake, No. 10 rubber-covered conductor can be utilized and a No. 5 solid porcelain knob can be substituted for the lead ball. The porcelain knob is placed on a hook bent in the end of the No. 10 conductor. When this end of the tool reaches an open space over the partition the knob is dislodged by loosening up the chalk-line and suddenly withdrawing the No. 10 conductor. Though both tools accomplish the same result, the mouse and looped snake arrangement of Fig. 142 is the most desirable because it is more substantial. The saving in time it will effect justifies the small expense of constructing the arrangement as a permanent tool.

268a. An angling rod for wire fishing can be arranged and used as suggested in Figs. 145*A* and 145*B*. The arrangement is particularly useful in fishing from a floor pocket in a story above to a basement through a side wall space, as shown in Fig. 146*B*. It can also be frequently utilized for fishing from a floor pocket to a side wall or partition outlet. The device is arranged as shown in Fig. 145*A*. A screw eye is inserted in the end of the smallest section of the rod. Additional screw eyes are inserted in each section, to form guides for the cord, unless the eyes already in the sections appear to be sufficiently substantial. A strong cord—a carpenter's chalk-line is good—is threaded through the eyes. A weight, preferably of lead and spherical so that it will readily roll over obstructions, is fastened to the end of the cord by threading the cord through a hole in the weight and tying a knot in it. If no other weight is available a porcelain insulator will do. A jointed gun-cleaning rod can be used instead of an angling rod for fishing short distances.

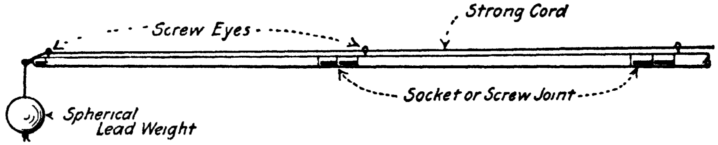


FIG. 145*A*.—Arrangement of angling rod for wire fishing.

The device is manipulated as indicated in Fig. 145*B*. The first section of the rod is pushed through the floor pocket toward the opening over the side wall or partition through which the conductors are to be drawn. The cord passes through the screw eye at the end of the rod and is held taut so that the weight is drawn up against the rod end. After the first section has been pushed through the pocket into the floor space, the second section, cord held taut in place, is joined to the first and pushed in also. The rod is thus lengthened by sections until the weight at its far end hangs over the space within the partition or wall. Then the tension on the cord is released and its weight will drop down within the space. It can be fished out at the basement ceiling or through the wall or partition outlet.

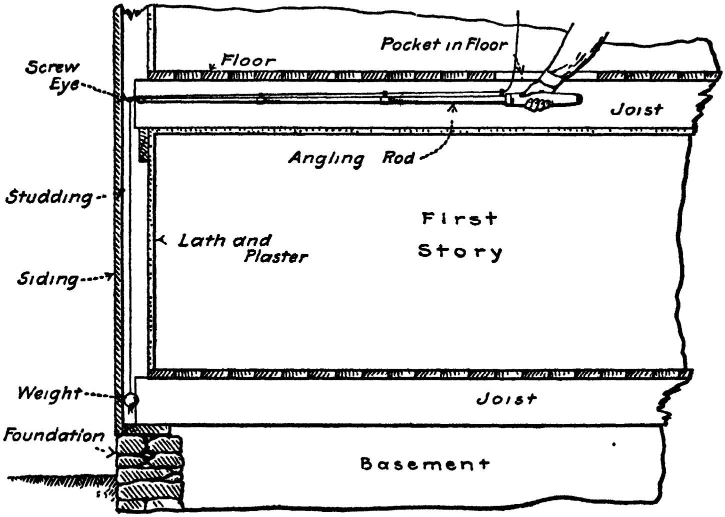


FIG. 145*B*.—Angling rod for fishing.

269. Conductors can be fished from a ceiling space into a partition space without the necessity of cutting a large pocket in the wall. The method of boring the ceiling plate for fishing the loom also the loom and conductors in final position are shown in Figs. 146 and 146*A*. The only visible mutilation necessitated by the process comprises two small holes in the partition near the ceiling. These need not be more than 1 in. in diameter and can be readily plastered up and covered by wall-paper. If the work is done properly it is impossible for one standing on the floor to detect where the holes were bored. The first hole is drilled as indicated at *A* in Fig. 146, diagonally from the room into the ceiling space. Hole *B* is bored so that it will go through the lower edge of the ceiling plate. By proper fishing, loom-covered conductor or flexible cable can be drawn into the wireway so as to assume the position shown in Fig. 146*A*. Where there is a molding in the corner between side wall and ceiling, the molding can be removed and then the holes can be so bored that they will be concealed by the molding when it is replaced.

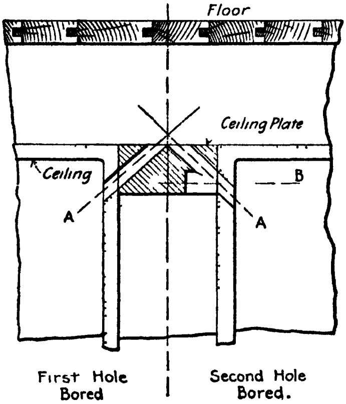


FIG. 146.—Boring ceiling plate for fishing loom.

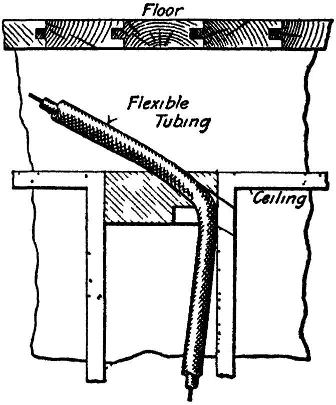


FIG 146*A*.—Loom and conductors in final position.

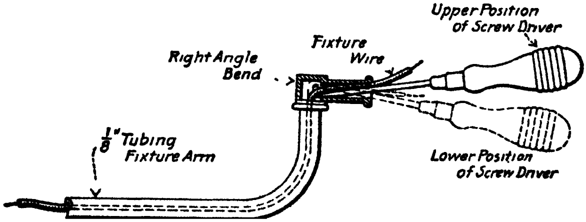

Upper Position of Screw Driver
Fixture Wire
Right Angle Bend
1/8" Tubing Fixture Arm
Lower Position of Screw Driver

FIG. 147.—Drawing wire into fixture arm.

270. A good method of pulling fixture wires past a right angle turn is pictured in Fig. 147. After the end of the wire has been brought to the opening of the fixture, a small screw-driver is inserted under the wire at the turn in the tube as illustrated. With each movement of the screw-driver from the upper position in the figure to that shown by the dotted lines, the wire will be pried out an eighth of an inch or more. As it is necessary to maintain a pulling strain on the wires as they come out, their ends should be fastened in a bench vice and the wireman should draw the fixture arm away from the bench as rapidly as the wire is pulled past the turn in the fixture. To start the conductors through the fixture a fish-wire should be used.

271. Fishing from a ceiling to a side-wall outlet without removing flooring is illustrated in Fig. 141. The method, which is employed chiefly when it is desired to install a bracket or switch on the outer wall of a room, requires the use of the mouse and looped snake arrangement, the detailed construction of which is shown in Fig. 142. In the application illustrated in Fig. 141 it was desired to place a bracket at the point *E*. At *A* a hole was bored through the baseboard, sill and floor. Through this opening the arrangement was inserted into the space between the floor of the second story and the ceiling of the first story. When the loop reached *C* the cord was loosened and the weight allowed to drop to a point *D* opposite *E*. Here the cord was fished out with a hook and the pair of conductors was attached. The conductors were then drawn through to *A*.

272. A method of fishing with two hooked snakes or wires is illustrated by Fig. 148. This plan frequently is feasible when it is desired to fish from a cellar to the space above the first-floor ceiling. One snake is pushed from the outlet hole in the first-story ceiling to the space over the partition. The other snake is pushed upward from the cellar. The two are then manipulated by the wireman and his helper until their two hooked ends engage. After attaching to one of the snakes the conductors that are to be pulled in, the whole combination is pulled through the wireway by the other wire. Sometimes it is preferable to pull through a pulling-in line, a strong cord or carpenter's chalk-line, before the conductors themselves are drawn in. No. 8 galvanized iron wire makes an effective snake for the above described application.

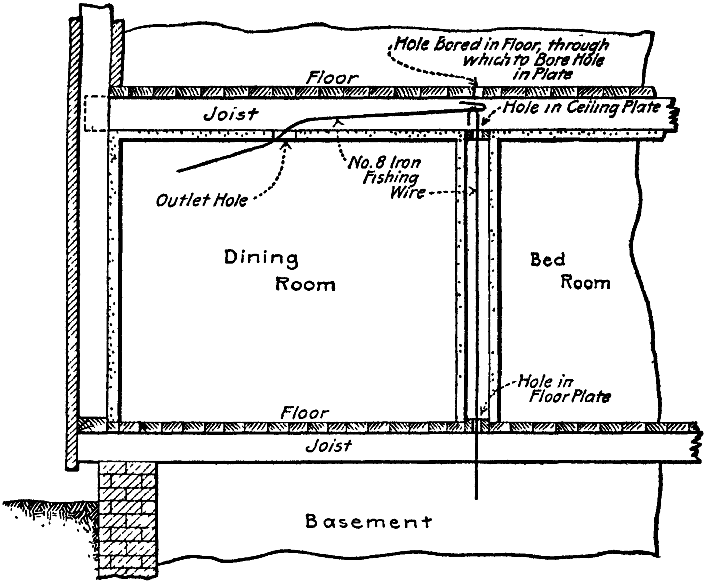


FIG. 148.—Fishing in partitions with hooked snakes.

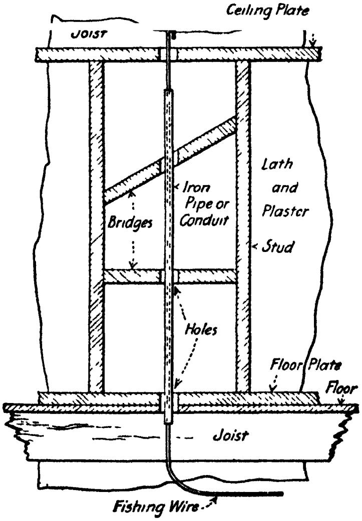


FIG. 149.—Iron pipe as guide for fishing wire.

273. Iron pipe as a guide for fishing wire eliminates much of the trouble of getting a snake through holes in the bridges of a wall or partition. Its use is pictured in Fig. 149. By inserting a length of quarter-inch pipe or conduit through the hole in the floor it is an easy matter to locate the hole in the bridge. When this distance has been tunneled, as it were, by the pipe, shove the snake through. After the wire has been hooked from above the pipe may be pulled out. In fishing downward, the pipe guide can also be used in which case it is desirable to use a mouse instead of a snake.

274. An electric-bell indicator may replace the wireman's helper in some instances of wire fishing. The method is pictured in Fig. 150. A bunch of bare copper wire is pushed into the outlet through which it is desired to fish and to this bunch of wire is connected one of the terminals of an electric bell and battery set. The other terminal of the bell is connected to a snake being pushed by the wireman. When he has pushed the snake into connection with the bunch of bare copper, the electric bell will give notification by ringing. It is then usually possible by pulling the bunch of copper wire out of the outlet to draw the snake with it, after which the conductors can be readily pulled in by attaching them to the snake. The snake should have a hook bent in its end with which to engage the bunch of wire.

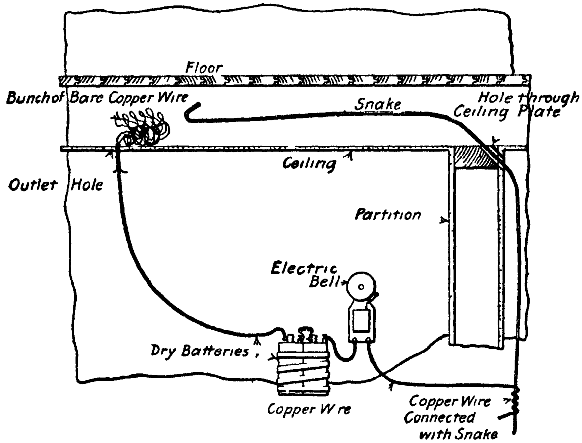

Floor
Bunch of Bare Copper Wire
Snake
Hole through Ceiling Plate
Ceiling
Outlet Hole
Partition
Electric Bell
Dry Batteries
Copper Wire
Copper Wire Connected with Snake

FIG 150—Electric-bell indicator for fishing.

275. A method of forcing conductors around the coved portions of a ceiling without any preliminary fishing is shown in Fig. 151. This plan is particularly applicable when steel armored conduit or cable is being installed. After the outlet hole in the ceiling has been made the cable should be inserted into the space between the ceiling and the floor above and pushed in the direction of the partition it is desired to enter. Often an opening will be found between the studs without the necessity of drilling through the plate topping the studs. When this is impossible the methods of fishing described in other paragraphs should be employed.

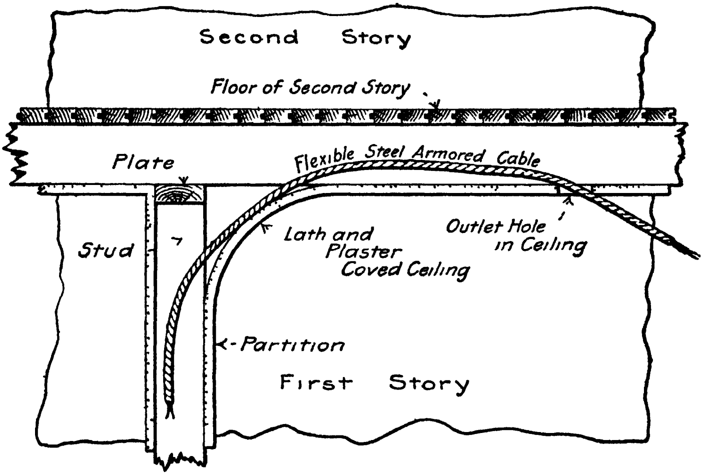


FIG. 151.—Forcing armored cable around a coved ceiling.

276. The Fishing of Conductors Laid on Furring Strips. Where a ceiling is plastered on laths which are nailed to furring strips and it is desired to run the conductors within the ceiling parallel to the direction of the furring strips (at right angles to the beams), the scheme outlined in Fig. 152 can often be adopted. With this method the removal of floor boards is unnecessary. The space, provided by the furring strips, between the tops of the lath and the bottom edges of the joists, furnishes the space through which the conductors can be drawn.

In installing conductors in such cases, a section of baseboard is removed from a partition as at *A*, Fig. 152, and a 1-in. hole for each conductor is bored through the floor plate and floor and into the space between the floor and ceiling. Where more than one conductor is to be drawn in the holes should be spaced about 4 in., horizontally, apart. A snake having a hook on its end is fed into each of the holes and worked along toward the point *B* in the space indicated by line *C* in the illustration. When the hooked end of the snake reaches the point *B* another hooked wire is pushed down through hole *D* and the two ends are twisted around until the hooks engage, after which the long snake can be pulled out with the short one. With the long snake, a pulling-in line can be drawn through and then the conductors either in circular loom or in flexible armored conduit can be drawn in. If difficulty is experienced in pulling in the conductors, draw through first a length of small steel armored cable and then have it pulled back and forth by a man at each end, which will produce a sawing action on the plaster above the lath and will cut away the plaster causing the interference.

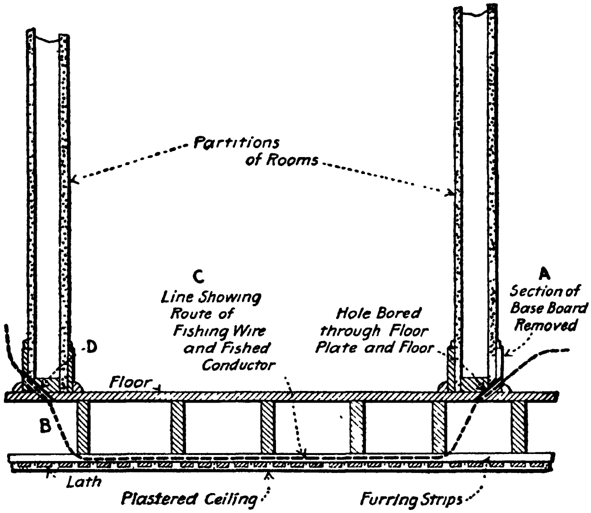

Partitions of Rooms
C
Line Showing Route of Fishing Wire and Fished Conductor
Hole Bored through Floor Plate and Floor
A
Section of Base Board Removed
D
Floor
B
Lath
Plastered Ceiling
Furring Strips

FIG. 152.—Method of fishing conductors in a furred ceiling.

RUNNING CONDUCTORS TO SIDE OUTLETS

277. Running wires to switch and fixture outlets in partitions is probably the most difficult work encountered in the wiring of finished buildings. As indicated in Figs. 179 and 181, a considerable percentage of the total wiring lies within partitions, and great ingenuity must often be displayed in running the conductors to specified outlets without damaging the walls. Where there is no bracing or other obstruction within a partition and the header can be reached from an attic or by removing floor boards, the operation is simple. A hole is bored in the header, a "mouse" (Fig. 129) is dropped through and the wires are pulled up, by attaching them to the mouse string, from the outlet hole in the partition to the hole in the header. All wires within partitions and in other places where they cannot be supported on porcelain must be sheathed with circular loom, which is slipped over the wires before they are pulled in.

278. There are several methods of getting conductors past obstructions to wall and partition outlets. In a great many cases, the bringing out of the switch loops at outlets at a proper distance from the floor is the most difficult part of wiring old houses, on account of the cross-pieces or bridges sometimes found in partitions. The method to be used must be determined by the wireman on the job, according to the conditions found. The procedure, as suggested by Howard H. Wood, is as follows:

First, with his mouse, he finds if the runway is clear; if so, the rest is easy. But, if he finds there are cross-pieces, he locates their position by measurement with the mouse, and marks the location on the wall. If the cross-pieces are above the proper positions for the switch, he will probably use one of the following methods (which are described in detail in succeeding paragraphs) of getting around them:

(*a*) Remove the door stop strip from the frame of the doorway (see **279**), bore through on each side of the cross-piece, and cut a recess in the inside of the frame, then fish the wires around.

(*b*) If on the second floor, and there is no partition directly above, the wireman can use a pipe-extension boring tool (Figs. 114 to 118), boring one hole large enough to fish the switch loop through.

(*c*) If the cross-piece is not too far above the proposed location of the switch, the holes can be drilled on a slant from the switch opening. (See Fig. 152*A*.)

(*d*) Remove the wall-paper directly over the cross-piece. Then cut a hole and bore holes or cut away the cross-piece so that the wires will pass. (See **280**).

(*e*) Sometimes a wireman will attempt to remove these cross-pieces, when he can get at them from above, by putting a piece of pipe down between the partition, and hitting with a heavy hammer. This method is liable to cause damage to the plaster by bulging or breaking it out, and is not recommended.

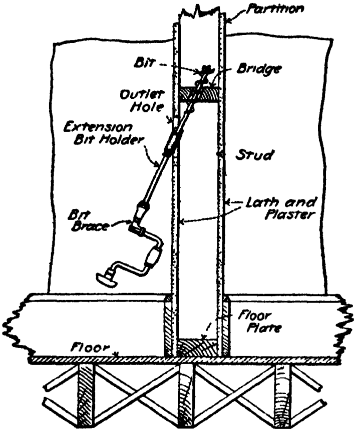


FIG. 152*A*.—Boring hole through bridge from outlet opening

(*f*) When a switch must be located on a brick wall, it is necessary to run wires in rigid or flexible steel conduit. The wall must be channeled, the conduit buried in it, and the groove replastered. At the point where the metal terminates under the floor a suitable outlet fitting must be provided. (See **285**.)

279. When a partition outlet is near a doorway, vertical con-

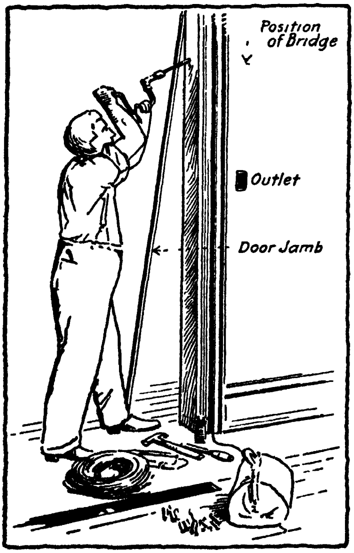


FIG. 153.—Boring holes around bridge.

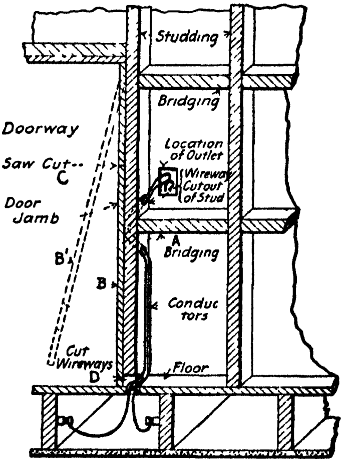


FIG. 154.—Carrying wires around a bridge.

ductors can be run past bridges within a partition by removing the door jamb and following the method illustrated in Figs. 153 and 154. In the case shown it was not feasible to bore down from above with the long-distance boring tool, so the conductors were carried up from below. The door jamb in such a case can either be pried loose and bent up, as shown at *B′* (Fig. 154), or a saw-cut can be made in the jamb as at *C* and the section *B* of the jamb can be removed. In either case the stud at the side of the door is exposed and wireways can be cut in its outer face around bridges or other obstructions, as shown. At the floor a hole can be cut through the stud, as shown at *D*, and through this hole another can be bored through the floor. The conductors are then carried through this floor hole into the space between the joists. The electrical codes of most municipalities require that all conductors within partitions and not supported on porcelain be carried in circular loom. Allowance must be made for this in boring holes and cutting wireways.

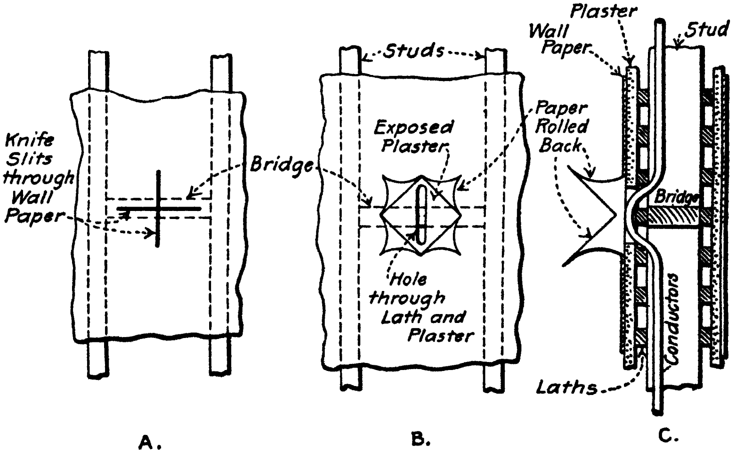


FIG. 155.—Carrying wires around a bridge when it is necessary to cut into plaster.

280. To carry conductors past a bridge in a wall when a doorway is not adjacent and when the long-distance boring tool is not applicable, it is necessary to cut into the surface of the wall as shown in Fig. 155 and as described in the following paragraph.

Through the bared plaster cut holes into the partition above and below the bridge, and remove enough plaster from in front of the bridge to leave a cavity that will accommodate the loom-covered conductors. The conductors may then be run in as suggested in the longitudinal section *C*. The hole left in the wall surface should be filled with plaster of Paris and the paper carefully replaced as described in **281.**

281. A method of cutting wall-paper to expose plaster for making a fishing hole without disfiguring the wall decoration is illustrated by Fig. 156 and by *A* and *B* of Fig. 155. With certain kinds of wall paper the method here described can be used with practically no visible damage. If the wall paper is such that moisture will disfigure it, this method should not be used Cartridge papers are not, as a rule, affected by a little water. In order to ascertain the effect of water on the paper in question, it will be necessary to experiment with a small area in an inconspicuous corner.

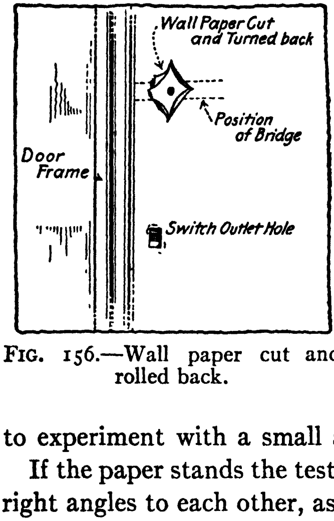


FIG. 156.—Wall paper cut and rolled back.

If the paper stands the test, two slits should be cut through it at right angles to each other, as suggested in *A* of the illustration, at a point just opposite the bridge. The bridge can be located by dropping a "mouse" on it from the outlet hole cut through the partition at a point above it. A very sharp knife should be used in cutting the slits.

Ordinarily, the paper should be soaked slightly around the slits with a wet sponge or cloth. When the water has been absorbed by the paper and the paste that held it to the wall has softened, peel back the four triangular sections of paper. A wide-bladed putty knife is a convenient tool for the purpose. Be careful not to crack or crease the paper. In old buildings where there are many thicknesses of paper on the wall they can, frequently, be removed without moistening. When the paper is completely "peeled" it will appear as shown in *B*, Fig. 155, and in Fig. 156.

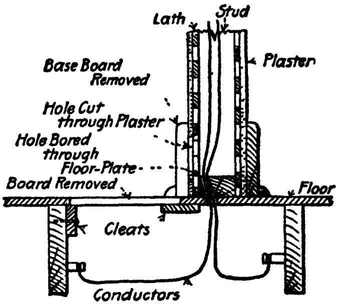


FIG. 157.—Method of cutting through 2 in. by 4 in. floor plate.

Should there happen to be a figure or flower in the wall paper design directly over the bridge within the wall, the double slit is not made, but instead the entire design is cut out of the wall paper with a sharp knife. A hole is now made through the laths and plaster to accommodate the conductors and they are drawn in. After they are in, the hole is filled with plaster of Paris and the design can be replaced on the wall so neatly that the casual observer will not know the wall-paper was cut. The hole in the plaster should always be somewhat smaller than the piece of paper removed from the wall.

282. Carrying Conductors Around or Through a Sill. A 2 in. by 4 in. sill is sometimes placed under the lower ends of studs that

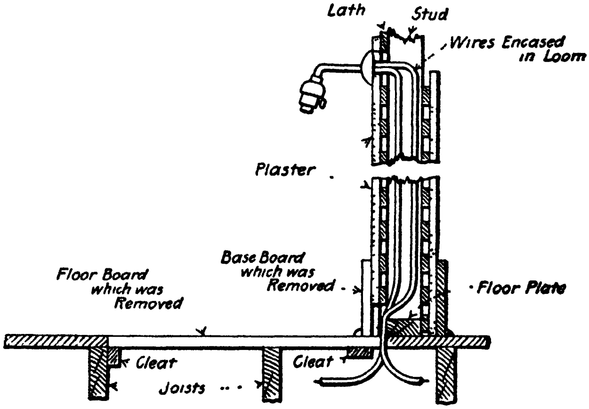


FIG. 158.—Method of wiring around a sill or floor plate.

form a partition, as shown in Fig. 157. Where this construction is encountered and it is not possible to bore through the sill from above with the pipe-extension boring tool, the baseboard must be removed as shown. After the baseboard is off, an orifice is cut through the lath and plaster and a slanting hole is bored through the sill and the floor. Sometimes it is not necessary to bore the hole in the sill as the wires can be run in a space formed by removing some lath and plaster, as suggested in Fig. 158. Where large conductors are involved it is usually necessary to bore through the sill.

283. Wiring between Partitions on Different Floors. Often the condition illustrated in Fig. 159 is encountered. It is necessary to draw conductors from an outlet in a partition in one story to an outlet in a partition in another story. Where the partition of the story above lines up with that of the story below, the conductors can usually be drawn in by cutting a pocket close to the foot of the partition in the second story. Where, as in Fig. 159, the partitions do not line up, it is more difficult to get the conductors in without disfiguring the building. Frequently

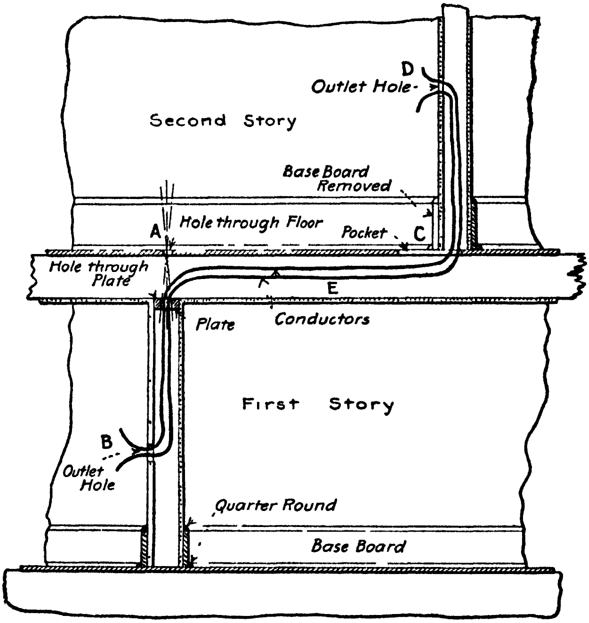


FIG. 159.—Fishing between partitions on different floors.

the partition in the lower story lies under a hall or other second story room that has a nicely finished bare floor from which the wireman does not dare to remove boards.

One solution of the problem is to bore one 5/8- or 3/4-in. hole directly over the plate of the first-story partition as indicated at *A*. Then through this hole, by pitching the bit and using one having a long shank or an extension bit, a half dozen holes can be bored through the plate—all through the one hole in the floor. Instead of making several small holes in the plate it is possible to make one large one by boring the small holes around in a circle and then knocking out the block with a bar or a piece of conduit. To draw in the conductors: A mouse or a fish chain is dropped in at *A* and pulled out at *B*. Then a snake is pushed in at *C*, through *E*, and drawn out with a hooked probe (see Fig. 139) at *A*. The snake and fish-wire are fastened together at *A* and the chain is drawn by the snake over to *C*. Now the conductors are fastened to the lower end of the fish chain which is extending from *B* and the conductors are pulled in over to *C*. From *C* the conductors are readily drawn up to *D*.

A plug of suitable wood, cut across the grain, and tapering so that it will fit nicely, is made for hole *A* and driven therein. Its top can be planed off flush with the surface of the floor and if its grain was selected to match that of the floor it will be difficult to locate.

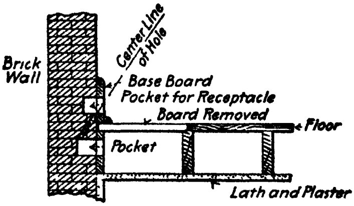


FIG. 160.—Pockets in brick wall for receptacle.

284. A receptacle for an extension plug mounted in a baseboard is a good substitute for a wall fixture when it is objectionable to channel a brick wall to the regulation bracket height of 4 ft. 6 in. The method is illustrated in Fig. 160. By means of an extension cord a portable or table lamp can be substituted for the wall fixture. It will be noted from the figure that it is not necessary even to remove the baseboard. A slanting hole is drilled from the pocket for the baseboard receptacle to another pocket cut beneath the floor. A short piece of conduit is then installed from the receptacle outlet to the pocket under the floor. Such a baseboard receptacle also forms a convenient means of attachment for portable vacuum cleaners and heating devices.

285. A method of running conductors to an outlet in a brick wall with minimum damage to finish and cutting of bricks is shown in Fig. 54. The baseboard is not removed. A cavity is cut for the metal outlet box (all conductors in brick walls must be protected with iron armor) and a groove is cut in the wall surface from the outlet cavity down to the baseboard. From this point a slanting hole is drilled to a pocket opening between the joists. To cut this pocket it is necessary to remove some floor boards. Flexible steel armored conduit is then connected to an outlet box, the box is fastened in the cavity provided for it by a screw turning into a lead expansion anchor, and the conduit is run through the hole back of the baseboard and placed in the groove.

286. When installing a flush switch, the method of pulling in the switch box is preferable to the reverse procedure of pulling the wires in from the opposite direction and connecting the switch last. In connecting wires to the switch by this method (see Fig. 161) the wireman is not hampered by having to work in the small space of an outlet box. Another advantage of the "pulling in complete" method lies in the diminished risk of damaging the plaster around the sides of the outlet hole. Where wires are pulled in and left protruding from the outlet until the switch can be connected they are necessarily handled to some extent, and thereby tend to break away the plaster.

The method in detail follows: First, cut the outlet hole the exact size of the box; second, make up conductors of the proper length, connect them to the switch and cover them with circular loom; third, drop a mouse into the hole from above, attach it to the wires, and pull in the entire unit consisting of switch, steel switch box, conductors and loom. The wires will draw the switch and its outlet box into place. The box is fastened in position with wood screws and the free ends of the conductors are soldered to their proper connections.

287. A method of installing a wall switch box when the use of screws alone does not insure substantial support is shown by Fig. 162. Flat-headed screws driven into the laths of a plastered wall often permit the switch box to become loosened within the outlet hole. In such cases wooden cleats should be introduced into the space within the partition and wooden screws driven through them as shown in the figure. The conduit for the switch having been made up, the box is then secured to the block by flat-headed wooden screws which pass through the lugs in the box provided for them.

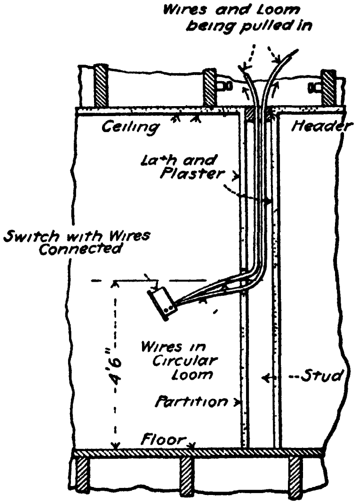


FIG. 161.—Method of pulling in switch box.

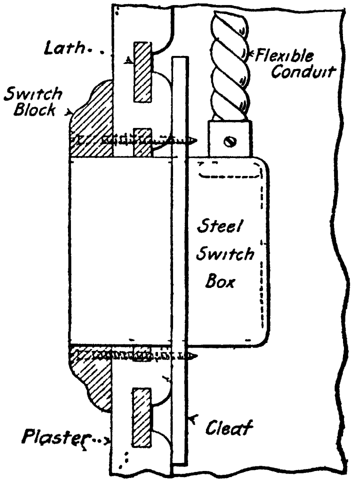


FIG. 162.—One method of mounting a partition switch box.

RUNNING CONDUCTORS TO CENTER OUTLETS

288. Fishing to Ceiling or Center Outlets. Almost invariably the joists are run parallel to the street. If the house is one with a side or center hall on the second floor, the circuits can be run the length of the hall, necessitating the removal of two boards, as shown in Fig. 26, for that distance. Wires can then be fished from the centers of the rooms below by cutting small holes at the chandelier locations, Fig. 163, or by cutting a pocket in the floor directly above the location of each chandelier outlet. If it is necessary to take up the floor boards of the hall at some distance from the partitions of the story below, other pockets must be made close to the partitions, in order to drop the switch loops, and to get through to the other side of the building. This is usually necessary when the hall is in the center, with the rooms to be wired on each side.

If there is no hall on the second floor, the boards can be taken up through the door-ways, and the wires dropped to the switches, outlets, and to the tablet board very readily. (See illustrations in chapter on "*Examples of Installations.*") Where there are hardwood floors, the wires must be fished from the center of the room below to a closet in the story above, or to a point where the baseboard can be removed so as to get into a partition going either up or down. In many cases, it is necessary to drop to the cellar, and then come up again in another location for the switch loop. Where this is necessary, the most convenient place for the tablet board is in the cellar.

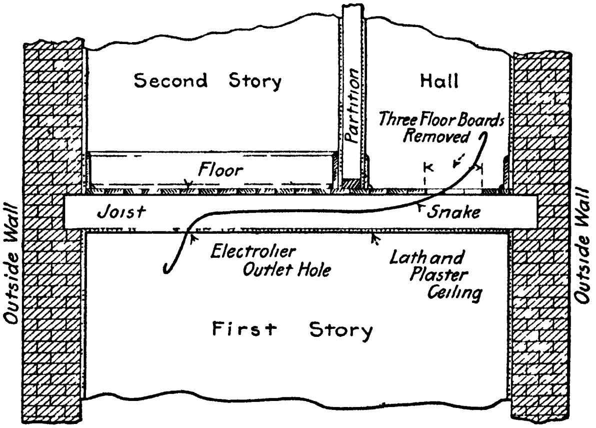


FIG. 163.—Fishing from a ceiling or center outlet to a pocket.

289. Reaching a Ceiling Outlet Located under a Parquetry Wood Border. Frequently, as shown in Fig. 164, there is a soft-wood center to the floor. Where there is, a pocket can be cut in this soft-wood portion and the outlet can be reached from the pocket by the application of a pipe-extension boring tool similar to that described elsewhere. The pipe sections for a boring tool for this work must be somewhat shorter than the distance between adjacent joists. The holes through the joists to the pocket can be bored diagonally as *AB*, Fig. 164, or they can be bored at right angles to the joists as *DC*. Where they are bored diagonally, directly toward the outlet, a chalk-line should be drawn on the floor surface, from the pocket to a point directly over the outlet, to assist in guiding the bit in the correct direction. The bit will actually follow a curved course as shown by the dashed line due to the offsets that occur when the bit passes from one joist to another and allowance should be made for this when starting it into the first joist.

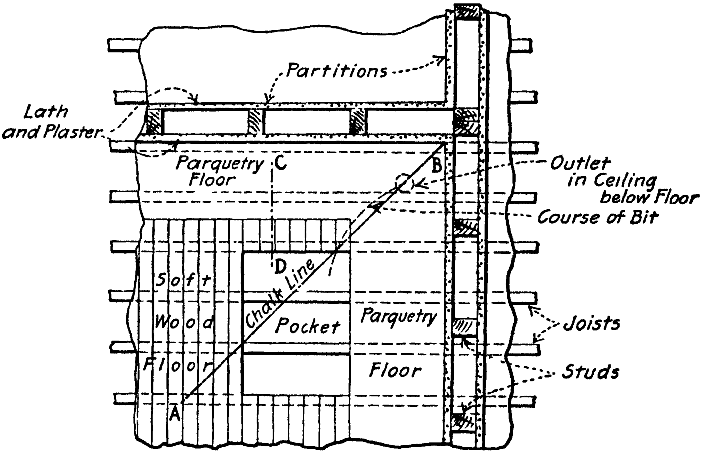


FIG. 164.—Plan of corner of room having a parquetry floor showing method of reaching outlet in ceiling below.

Although, when a wireway has been bored diagonally direct to the outlet, the snake can be easily pushed to the outlet through a pipe guide—the pipe sections of the boring tool are used for a guide—(see **273**), there are disadvantages to the method. The bit may encounter bridges or nails which will block the path. It is usually preferable to bore the holes through the joists approximately at right angles as indicated by *DC*. When this is done, bridging and nails can, usually, be avoided. The snake is then pushed along the path *DCB*. So that the snake will readily take the turn at *C* toward *B* the holes *DC* should be slanted somewhat toward *B*.

290. A method of wiring from a partition outlet to a ceiling outlet or a pocket without disturbing baseboard or floor is shown in Fig. 165. The molding trim is removed and a hole, so located that it will not show when the trim is replaced, is dug in the plaster. Then through this hole, diagonally downward so as to pass through the floor within the partition, a hole is bored with a large Syracuse twist bit or a ship auger. The wireman can readily fish from the outlet hole in the partition to the hole bored back of the molding trim. In many cases the run can be fished from the hole back of the molding trim to a ceiling outlet pocket. It is also sometimes possible to fish from the hole over to and down inside of an outer wall, in a wooden house, following the method described in **265.**

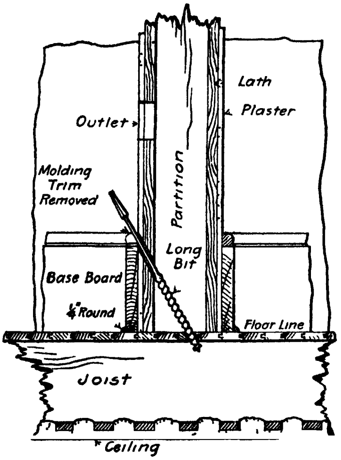


FIG. 165.—Method of wiring from a partition outlet to a ceiling outlet or a pocket without disturbing baseboard or floor.

MISCELLANEOUS METHODS

291. A method of running conductors from a floor pocket to a partition above without disturbing the baseboard is illustrated in Fig. 166. The quarter-round in the angle between the baseboard and the floor is first taken up. This is accomplished by punching the nails through with a nail set (see **221**). Then a hole, 1/4 or 5/8 in. in diameter, is bored through the floor to provide a starting place for a compass saw. A length of floor board is then taken up, making a floor pocket. A hole is bored up-

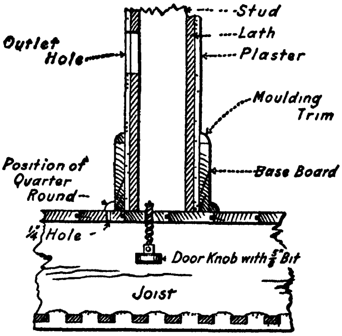


FIG. 166.—Method of running wires from floor pocket to partition above without disturbing baseboard.

wardly from this pocket through the floor with the door-knob bit (Fig. 113) as shown in Fig. 166. This hole being bored, the route from the pocket to the outlet hole is complete. The floor board should be replaced in accordance with the method illustrated in Fig. 104 and described in an accompanying paragraph.

292. Drills for piercing brick are shown in Fig. 167. The simplest to construct and probably the most useful of these tools is shown at *A*. This drill is made by cutting off at an angle an ordinary piece of iron pipe or conduit, of the same diameter as the hole to be drilled. This tool tends to break away less of the material of the wall at the outside of the hole than do most other drills. The star drill, *C*, is a commercial article and can be purchased at hardware stores. A good drill of the form shown at *B* can be made by the wireman with a three-cornered file by cutting teeth in one end of a piece of conduit. An extra heavy steel pipe which can be obtained at any plumbers' supply house will make a more serviceable tool. For general work in reasonably soft walls the pipe drill is preferable to the star drill. The cutting edges of the star drill frequently break off, rendering it useless, and sometimes obstruct the hole. In deep holes the pipe drill "clears" itself much more effectively than the other.

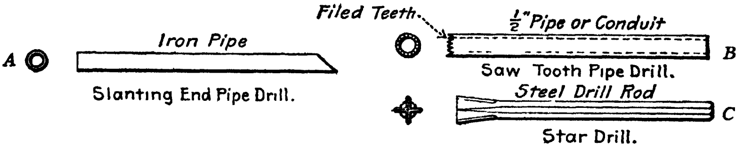


FIG. 167.—Drills for boring brick.

To drill through soft brick or "adobe," which is much used in the South, a common bit may be used in a brace after the feed screw or screw point has been filed off. This will make a clean smooth hole and will not break away the material of the wall as is likely to be the case when a pounded tool is used. An old, much-worn bit should be used for this purpose as its cutting edges are worn and it is valueless for any other purpose.

293. Soldering Connections in Finished-building Wiring. An alcohol torch is best, chiefly for the reason that a wireman can solder each joint as he makes it and thus be sure that none is left unsoldered. A gasoline blow torch is not as good for the work; *first*, because it requires too much time to start the flame and *secondly*, because the flame is so intense there is constant danger of fire from ignited dust or chips falling into partitions. Satisfactory work can be done with a soldering copper heated by a blow torch or a gas stove, but it is not feasible always to keep it in readiness for immediate use. Fig. 168 shows an alcohol torch of satisfactory design which costs about a dollar. Wood alcohol, purchasable at any drug store, is the fuel. It is possible, using wire solder, to make a soldered splice in conductors as large as No. 4 B. & S. gage with a torch like that shown in Fig. 168. An alcohol torch is seldom satisfactory for conductors larger than No. 6, and then a gasoline blow torch must be used. With an alcohol torch it is not necessary to use the air blast for small wires, but with larger sizes the hot flame needed can be obtained by blowing through the rubber tube. The blow-pipe tube can be adjusted vertically to compensate for the burning away of the wick and to change the size of the blast flame.

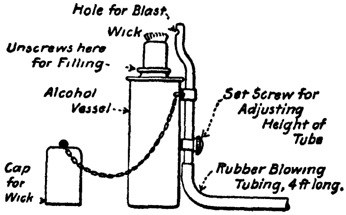
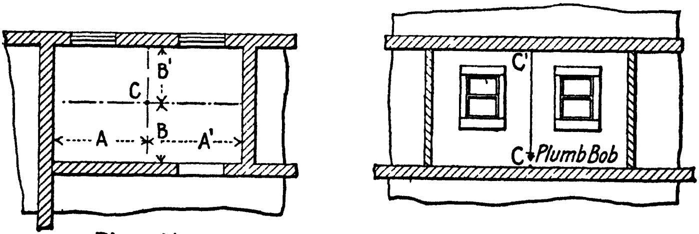

Hole for Blast
Wick
Unscrews here for Filling
Alcohol Vessel
Set Screw for Adjusting Height of Tube
Rubber Blowing Tubing, 4 ft long.
Cap for Wick

Fig. 168.—A satisfactory type of alcohol torch.



Plan View. Sectional Elevation.

Fig. 169.—Locating center of ceiling.

294. A convenient method of locating the center of a ceiling, preparatory to installing a ceiling fixture, is shown in Fig. 169. The wireman measures the length and width of the room, on the floor, as indicated by A, A', B and B', and locates the room center C on the floor. Then with a plumb bob the point C is transferred to the ceiling, as shown at C' in the sectional elevation of the figure. Where there are two men on a job, a string can be used for locating the room center, but where there is but one man the above method involving the use of a rule is the best.

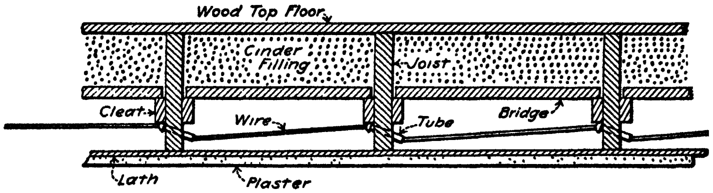


FIG. 170.—Wire installed beneath cinder floor.

295. Wiring Buildings with Cinder-filled Floors. A wireman will occasionally encounter a floor partly filled with cinders between the joists, Fig. 170. Floors are seldom built in this way now, but fifteen or twenty years ago the construction was common in the better class of residences and business buildings. The cinder filling was intended to prevent the transmission of sound from one floor to another and to stop the ravages of rats.

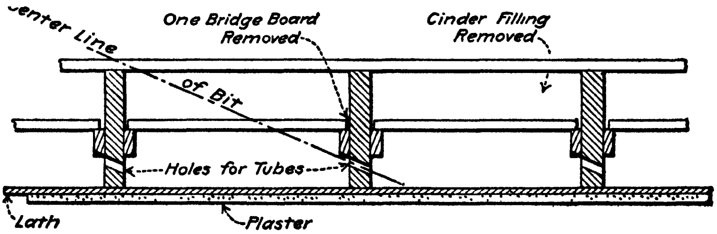


FIG. 171.—Boring tube holes through joists.

In running circuits beneath such a floor the wireman can take out some of the cinders after removing the floor boards parallel to the run. Only enough cinders should be taken out between each pair of joists to expose a complete "bridge" board so that it can be pried out. The bridge board out of the way, the holes for the tubes, or for flexible conduit if such is used, are bored below the cleats with a long bit. The latter type is necessary because one of ordinary length cannot be used, owing to insufficient working room. If a long bit is not at hand, one can be made by having a blacksmith weld a shank of the necessary length, possibly 30-in., to an ordinary carpenter's bit. Fig. 171 illustrates the conditions that prevail while the joists are being bored.

After the porcelain tubes have been inserted and the wire threaded through them, or after the flexible conduit has been run through the holes, the bridge pieces may be nailed in place. The cinders may then be scraped back and the top floor boards relaid. Fig. 170 illustrates a sectional view of a finished job.

CHAPTER X

EXAMPLES OF INSTALLATIONS

INSTALLATIONS WITHOUT PANEL BOXES

296. The Wiring of a Finished Frame Building by the Knob and Tube Method. It is the object of this description to outline in detail the procedure followed and the methods used in the recent wiring of a seven-room, frame residence that was erected about twelve years ago. The floor plans of the building are shown in the accompanying illustrations. The installation is typical of many that are now being made throughout this country and of many, many more that must be made before the field that is now available to the central stations is saturated.

The desideratum in this instance, as is frequently the case with frame buildings of the type illustrated, was to get a fairly good electric lighting system in the house. It was piped for gas when built, but the owner had difficulty in renting it without electric lighting. He put in the simplest possible electric outfit and omitted all frills.

It was decided to install flush wall switches for the principal rooms only. The living-room, library and dining-room were to have them but the kitchen, bedrooms and bathroom were to be provided with pull-socket fixtures. The two hall lights, one up-stairs and one down, were to be controlled by two flush, three-way switches, one located in the first-story hall and the other in the second story at the head of the stairs. For the cellar one porcelain key socket was to be provided, controlled by a surface wall switch in the cellar stair entry. A porch light, baseboard outlets and the like were omitted to minimize cost but provision was made for ultimately placing them with little difficulty providing conditions necessitated their installation.

Fig. 172 is a perspective view of the residence and Figs. 173, 174 and 175 show respectively floor plans of the basement and

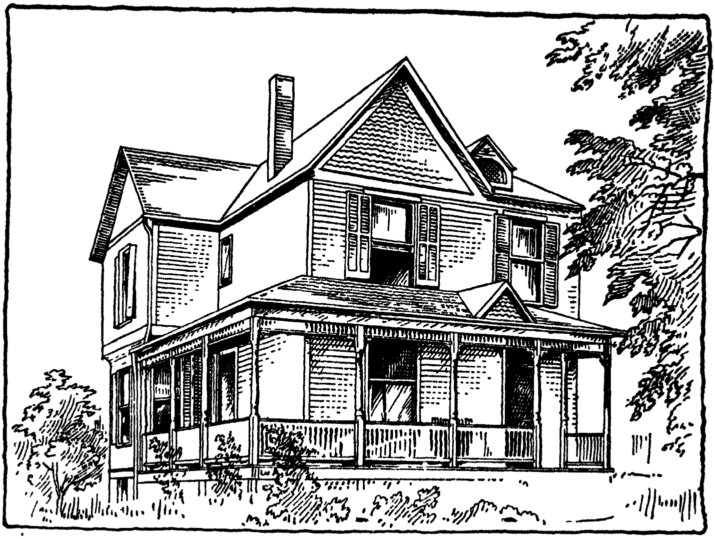


FIG. 172.—Exterior view of building that was wired.

first and second floors. Fig. 176, an isometric view, delineates with reasonable accuracy the arrangement of the entire installation. This illustration is not quite correct in certain minor par-

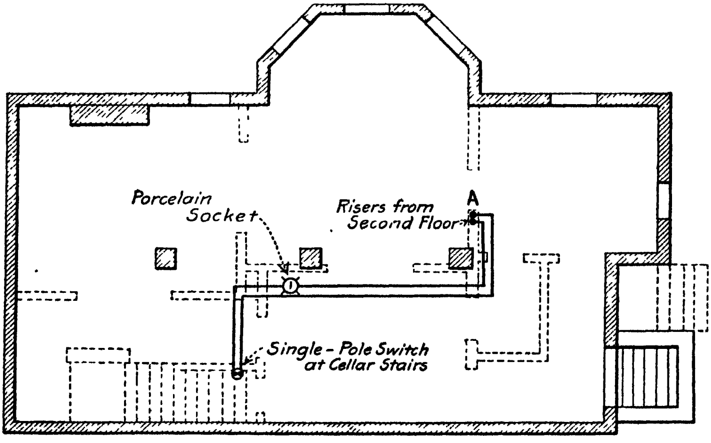


FIG. 173.—Floor plan of basement and also wiring in basement ceiling. (Dotted lines show locations of partitions on first floor.)

ticulars, which will be indicated later, because it could not be made strictly accurate without confusing complications in drawing.

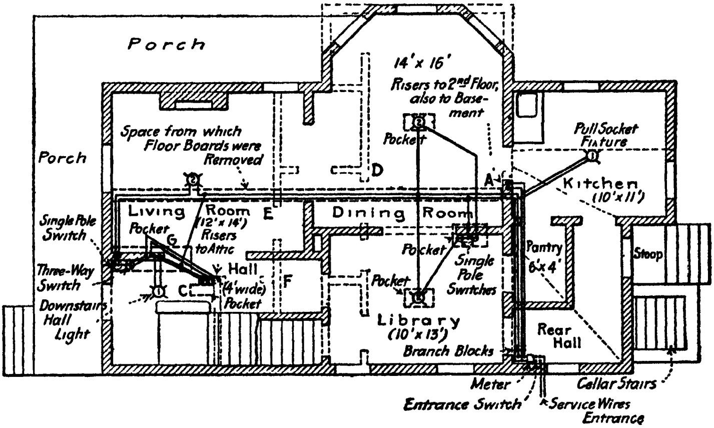


FIG. 174.—Floor plan of the first story and also wiring in the first story ceiling and partitions. (Light dotted lines show locations of partitions of second story. Heavy dotted lines indicate where boards of second floor were taken up to make pockets.)

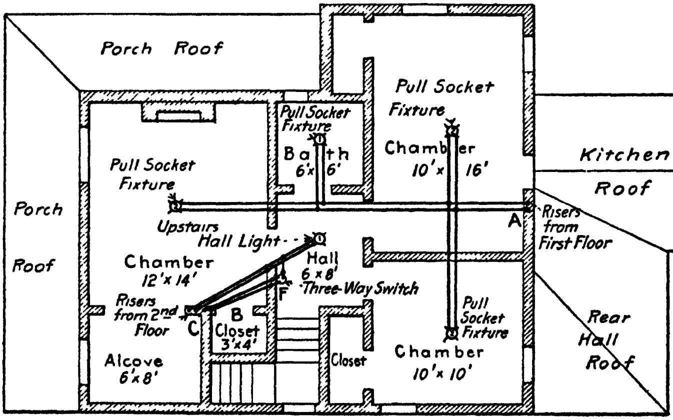


FIG. 175.—Floor plan of second story and also wiring in attic and in second story partitions.

The first step was to carefully survey the residence. It was discovered by probing with a mouse that a vertical raceway, indicated at *A* in Figs. 173, 174 and 175, sufficiently large to accommodate several conductors, extended from the basement ceiling to the roof. This was obviously the logical location for the risers. It was found that there were no obstructions in the attic, that it had no floor and that from it the entire ceiling of the second story was available. This facilitated the installation of the principal part of the work on that floor. The floor boards of the second floor ran lengthwise of the building and enough of them were taken up to indicate that a branch circuit could be readily carried within the first-story ceiling, the length of the house, as outlined in Fig. 174, to serve the wiring for the first story. The selection of the routes for the conductors for the two hall lights, one on the first and one on the second story, and for the three-way switches controlling them gave some trouble. Finally, however, after cutting a couple of exploring pockets, one in a closet, *B* Fig. 175, and the other in the inconspicuous corner *C*, the wire route shown was determined.

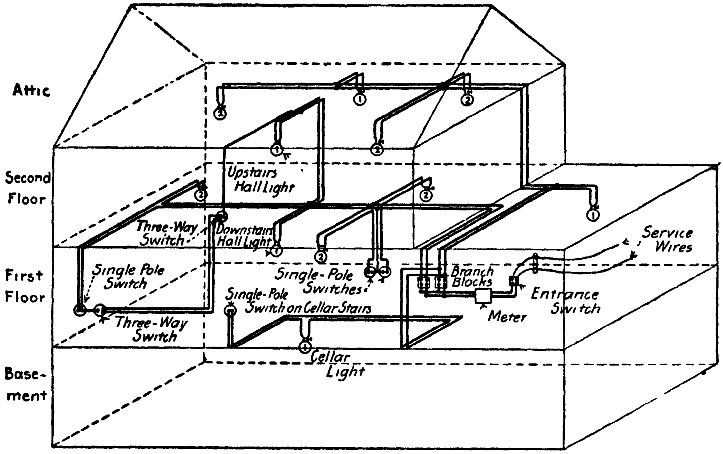


FIG. 176.—Isometric view of entire installation.

The general lay-out of the wire routes having been determined, the next move was to locate the point of entrance of the conductors into the building and the best location for the meter and the entrance switch. As shown in Figs. 174 and 176, the entrance was made near the rear of the house into the back hall. The local central-station company specifies that the interior wiring between the point of entrance and the meter shall be as short as possible and also that the meter be placed where it will be clean and dry and where it can be easily inspected and read. The rear hall location satisfied all of these requirements. The actual arrangement of the equipment about the point of entrance is detailed in Fig. 177. This portion of the job was very quickly placed because the interior of the rear hall had never been finished. The outside wall at this point consisted merely of clapboarding nailed to 2-in. × 4-in. studs. The loom-encased entrance wires were brought into the hall and to the entrance switch each through a 5/8-in. hole bored through the clapboarding. A vertical cleat was nailed to the face of each of two adjacent studs (see Fig. 177) and to these cleats were spiked two boards. One was

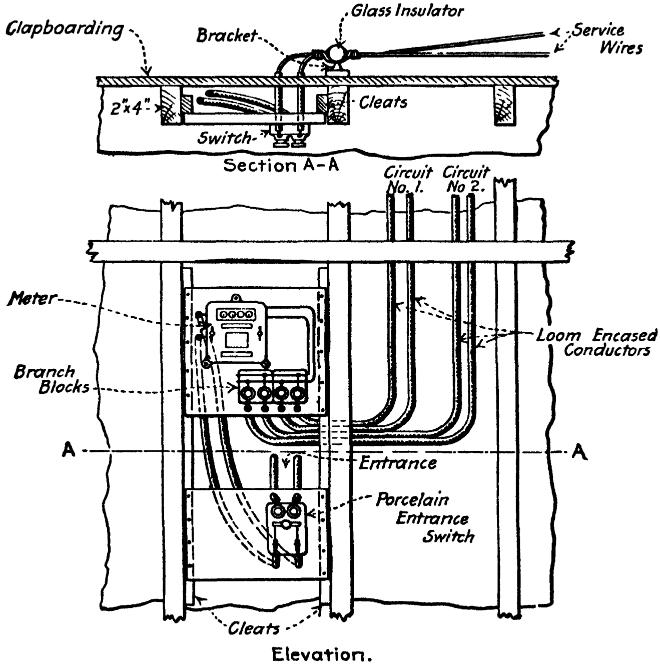


FIG. 177.—Method of installing service switch meter, and branch blocks.

for mounting the meter and branch-blocks and the other was for the entrance switch. To comply with *Code* rules, the fused entrance switch was so mounted that the fuses protect the switch and so that gravity tends to open the switch blades rather than to close them.

The entrance switch is of the porcelain-base, knife-blade type and is provided with receptacles for Edison-plug cut outs. The price of a switch of 30 amp. capacity, the size used, is 50 cents. From the inner side of the entrance switch, the conductors pass to the meter and from the meter to the branch-blocks, which, in this installation, constitute the distributing center. Where there was any possibility of the conductors coming closer together than the minimum distances specified by the *Code*, they were encased in loom. It is cheaper, in a confined situation of the sort illustrated in Fig. 177, to entirely cover the conductors with flexible tubing or loom than it is to use tubing on part of the wiring and support the balance on porcelain.

Another feature that was considered before much work was done was the assigning of the different outlets to branch circuits. The question was, how many branch circuits should be used and what portion of the building should each branch circuit serve. The *Code* specifies that there shall not be more than sixteen sockets, or instead a capacity of 660 watts of incandescent lamps served by any one cut out. In the installation under discussion there are exactly sixteen sockets or, assuming that a 40-watt lamp would be used in each socket, the total load would be 16 × 40 = 640 watts.

Evidently, it would have been permissible to have connected all sockets in the building to one branch circuit and yet have the installation meet *Code* requirements. However, if this had been done there would be no spare capacity to accommodate outlets that might be added in the future and the installing of an additional branch circuit after the job had been completed and the floor openings closed would be very expensive. Hence, it was decided to provide two branch circuits. One circuit was arranged to feed the second story and part of the first and the other most of the first story. The cellar light was connected to the branch serving the second story because in the second story there are seven sockets while in the first story there are, including the second-story hall light which must be fed from the first-story branch, nine. Furthermore, a large porportion of the first-story lights are likely to burn at one time, whereas this is not so apt to be true of the second-story lights. The kitchen light was also connected to the second-story branch to further lighten the load on the first-story branch.

Ordinary two-wire, porcelain Edison-plug cut outs costing 25 cents each were used for the branch blocks as indicated in Fig. 177. Edison-plug fuses of 10 amp. capacity were used for the protection of each wire. Both branch circuits were of No. 14 rubber-covered wire and the wire from the outside of the building to the entrance switch was No. 10.

Frequently, as in this installation, it is desirable to locate the distribution center at a point near the center of the building that is served. In the case being considered it would have cost more to have located it near the center of the building and the desirable feature of having the distribution center near the entrance switch would have been lost.

In installing the wiring for the first-story lights (Fig. 174) the first operation was to remove three floor boards of the second floor the entire length of the building, as indicated in Fig. 174. The course of this long pocket was so selected that it passed directly over the living-room electrolier outlet, rendering the cutting of a separate pocket for this outlet unnecessary. The pocket passed through the doorway at *D* but under the partition at *E*. Pockets were cut over the library and dining-room outlets and the tap conductors for them were readily fished between the joists to the branch conductors in the long pocket. These branch conductors, extending the length of the second-story floor, were threaded through tubes resting in holes in the joists. The tap conductors to the outlets were supported on porcelain knobs held to the faces of the joists with nails driven through leather washers and then into the knobs.

For carrying the wires to the two single-pole flush switches for the library and dining-room lights respectively, it was necessary to cut a pocket over the partition between the dining-room and the library. The conductors were carried down within the partition in circular loom. The outlet for the living-room electrolier was wired from the long pocket, and its single-pole flush switch was wired by cutting a pocket over the partition between the hall and the living-room. The method of getting the conductors to the hall lights and to the three-way switches controlling them will be described later.

All of the wiring for the second-story outlets, with the exception of that for the hall light, was placed with little difficulty. One of the branch circuits from the distribution center was continued as a riser from the point *A*, Fig. 174, in the first-story ceiling to point *A*, Fig. 175, in the attic over the second story. Then the branch was extended horizontally almost the length of the building—far enough to tap the outlet for the front chamber. In the attic the conductors were supported on the joists on split porcelain knobs held in position with nails. The attic could be entered by a trap-door in the bathroom ceiling and there was ample space in it for the wireman to move about and do his work.

Although the method of wiring for the hall lights and of connecting the two three-way switches controlling them is shown in the floor plans and in the isometric view, it is better illustrated in the detail of Fig. 178. It will be noted from a study of the floor plans that it was not feasible to route the conductors required for these lights and switches along as short a path as would have been possible with a job in a building under erection. An inspection of the construction of the residence disclosed that the most economical wiring would be as suggested in Fig. 178. The conductors for the first-story, three-way switch were carried down from the ceiling within the partition encased in circular loom. Then all of the conductors were carried, encased in loom, within another partition between the second-story floor and its ceiling (Figs. 174, 175 and 178) and then the three conductors for the second-story, three-way switch were carried back down still another partition. The reason for adopting this routing is not altogether obvious from Fig. 174 because parts of it are not drawn quite to scale. Actually the downstairs hall light is so close to the pocket *C* (Fig. 174) that its outlet was readily wired from *C*. Also, the bottom of the partition, in which the four risers to the attic are installed, is available from *C*. Hence it was easier and cheaper to carry all of the hall-light wiring up inside the partition at *C* and then bring the switch wires back down again in partition *F* than it was to carry the conductors over to *F*, within the first-story ceiling, which would necessitate cutting another pocket in the second-story floor under *F* and the removal of more floor boards. The conductors for the hall-light wiring were encased in circular loom within the partitions. In ceiling spaces they were carried by knobs and tubes and in the attic they were supported on porcelain split knobs nailed to the joists.

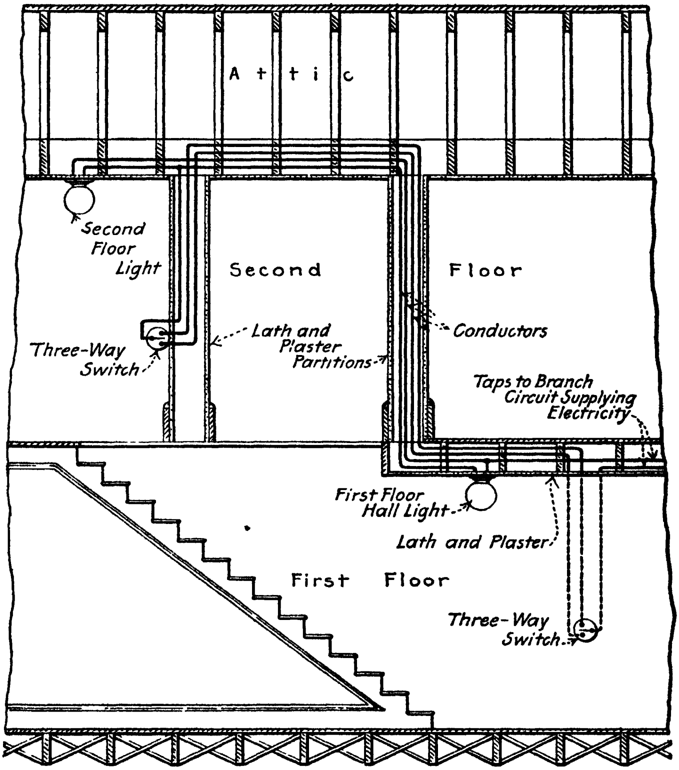
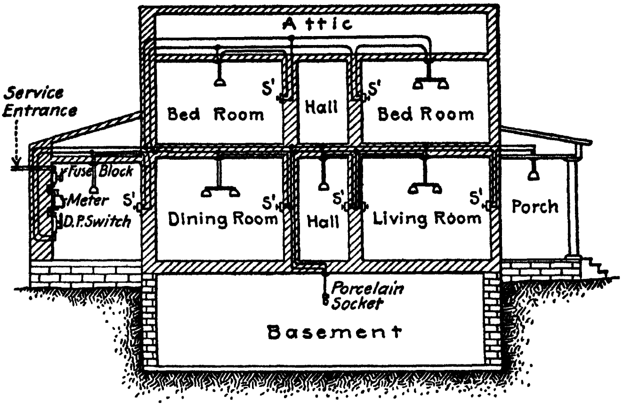


FIG. 178.—Detail of wiring for hall lights with three-way switches.

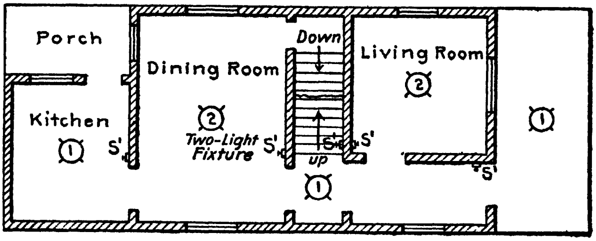
For illuminating the cellar only one porcelain socket was installed initially. It was located midway between the furnace and the coal bin. The tap circuit for the cellar light was connected to its branch at the point *A*, Fig. 174, in the little attic over the kitchen and the riser was dropped down within the partition *A* to the cellar where the tap was carried to the socket and to the surface wall switch located in the cellar stairway, as indicated in the basement wiring plan, Fig. 173. As previously suggested, the cellar light was connected to the upstairs branch circuit. The connection was effected at the point *A* (Fig. 174) because there was a straight runway, that had been left by the house builder, direct to the cellar from this point. This route could be followed without any boring or cutting, hence the loom-encased risers were drawn into it. In the cellar the wires were run at right angles to the joists, and were threaded through holes that were bushed with porcelain tubes. Where running parallel to the joists the wires were supported by split knobs nailed to the joist faces. Where the conductors were carried up within the partition to the surface wall switch they were encased in loom.

The isometric view of Fig. 176 is included to give a general idea of how the wiring for the entire installation was routed and of how it was connected. This isometric view is not quite correct in certain details because making it correct would have considerably involved the drawing. The points that are in error are these: (1) The basement branch circuit actually connects to the second-story branch circuit near the point where the kitchen light taps off instead of at the branch-block as shown by the drawing. (2) The routing for the wiring for the hall lights and their switches is actually arranged as shown in the floor plans and in Fig. 178, instead of as indicated in the isometric view, although the circuit of the isometric view is correct.

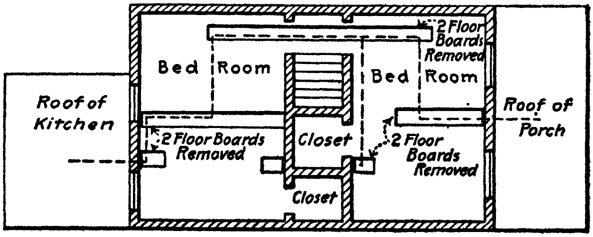
The installation was made by a local electrical contractor. His price for roughing in, that is, for the job complete with switches but without fixtures, was $48. This is at the rate of $3 an outlet, counting each switch and lighting fixture position as an outlet. The work required the time of a wireman and one helper for two days and netted a comfortable profit for the contractor.



Cross Section.



First Floor.



Second Floor.

FIG. 179.—Wiring a small frame building.

297. Example of Wiring a Small Frame Building. Frame houses present the easiest field for finished-house wiring, inasmuch as the spaces in the outside walls can be used for wire runways, and outlets can readily be cut in the outside walls. Where outside walls are of brick it is usually very difficult to install outlets in them without doing considerable damage, unless the walls are furred.

Fig. 179 shows the cross-section and first- and second-story plans of a typical five-room finished frame house and the methods used in wiring it. Referring to the cross-section, the wires enter at the rear of the kitchen and pass through the wall to the main fuse-block, the point of entrance being determined in any case by the location of the nearest available tapping-in point on the pole line and by the location of the meter. It is always desirable to locate the meter as near the entrance as feasible, making the unmetered run within the house very short. From the fuse-block the wires pass within the wall to the meter and thence again within the wall to the main switch. Leaving the main switch, the conductors rise within the wall, forming the distributing circuit for the house.

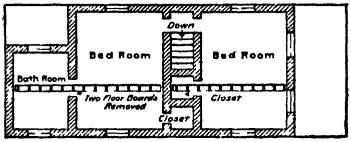


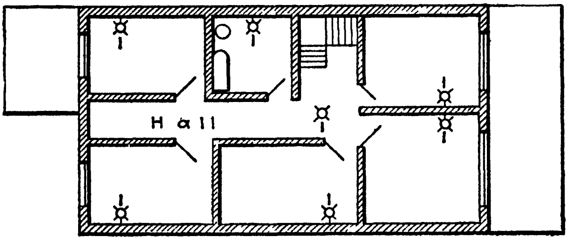
FIG. 180.--Second story plan of a house showi[illegible] in one continuous line.

In the case of a small house, such as that shown in Fig. 179, the total connected load is less than 660 watts, and so no branch cut outs are necessary. The one cut out at the point of entrance serves for the whole house. Fig. 179 indicates how the wiring to the switches and fixtures is concealed within floors, walls and partitions. It seldom is necessary to expose any wire in wiring a frame house. The spaces within the walls of a frame house are rarely "blocked;" that is, they are seldom obstructed with bridges or timber. Vertical circuits can, therefore, easily be run within them.

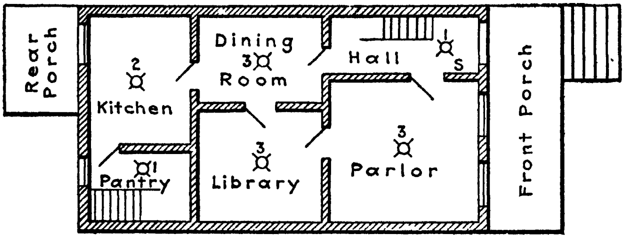
The diagram of the first floor shows the location of switches and fixtures for that floor. The second-story plan indicates the routes of the wires serving the first-story equipment and shows the floor boards which it was necessary to remove to run the wiring through and between the joists. The methods of removing and replacing floor boards are described in other paragraphs. Where floor boards must be removed for quite a distance in one continuous line, through several rooms, it is best to select an unobstructed route such as that through the door-ways in the second-floor plan. If a route is selected that passes under partitions there will be difficulty in getting the boards up without considerable sawing. Where it is possible and feasible to remove the floor boards in a continuous line it can be done as shown in Fig. 180. In any case, the location of the floor boards that are removed should be such that the pocket thus formed will be accessible from a maximum number of outlets. Frequently only one line of floor boards is removed as shown in Fig. 180 and all of the outlets are accessible from this line.

297a. Description of the Wiring of a Two-story and Cellar Building by the Knob and Tube Method. (This is abstracted from an article by T. W. Poppe in *Electrical World*, Feb. 4, 1909.) The owner desired lamps located as follows (Fig. 180*A* shows floor plans of the building): One lamp in each of the three divisions comprising the cellar; a three-lamp electrolier in the parlor; a similar one in the library and in the dining-room; a two-lamp electrolier in the kitchen and a lamp on flexible cord in the pantry. A switch was to be located in the pantry to control the three lamps in the cellar. A one-lamp fixture was to be mounted in the first-story hall. The switch for controlling this lamp was to be placed in the corner of the hall near the door into the parlor and also near the one to the street so that it could be conveniently reached from either. On the second story a one-lamp bracket was to be placed in each of the five bedrooms and one in the bathroom. In the second-story hall a flexible-cord and-socket drop lamp was so placed as to illuminate the entire room.

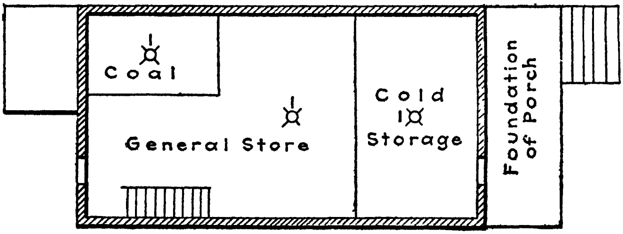
A total of twenty-four lamps was installed. To satisfy the Underwriters' requirement, which limits the wattage on a branch circuit to 660, the lamp outlets were so apportioned on two branch circuits that each branch circuit served twelve sockets. The best arrangement, all things considered, appeared to be to connect the outlets for the parlor, library, dining-room, and hall and for the two brackets in the front bedroom on the second story, to one branch circuit. All of the other outlets were connected to the other branch circuit.



Second Floor.



First Floor.

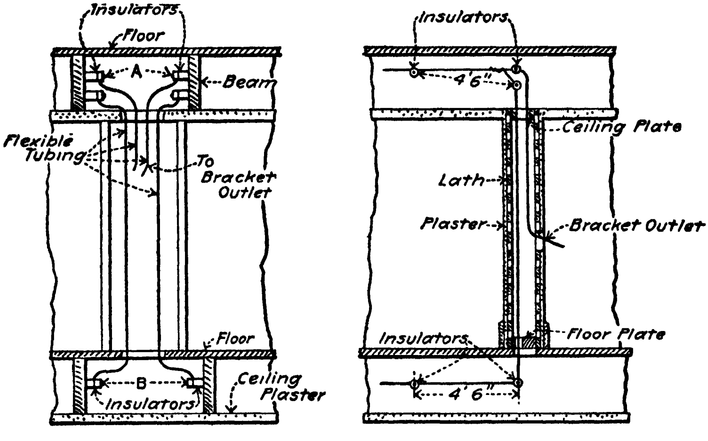


Cellar.

FIG. 180*A*.—Floor plans of building.

Service was obtained from an aerial alternating-current line, hence the entrance was made in the attic. The service switch and cut out, the meter and the branch-blocks were located at this point.

The front bedroom brackets were then located and a pocket was made in the attic floor by removing a floor board directly over the partition upon which the brackets were to be mounted. Through the 2-in. × 4-in. ceiling plate (Fig. 180*B*), four 3/4-in. diameter holes were bored. Then through two of these holes a pipe extension boring tool (Fig. 114) was inserted and two 3/4-in. diameter holes were bored through the floor plate (Fig. 180*B*) of the second floor. (It was necessary to exercise care to avoid slanting the bit and boring through the lath and plaster partition and out into the room.) This brought the bit of the pipe-extension tool into the cavity formed by the: (1) *Joists supporting the second floor*, (2) *the lath and plaster of the first-story ceiling and* (3) *the second-story flooring*. Just below the brackets, in the second-story floor, a pocket was made by removing a couple of lengths of floor board. This pocket afforded access to the bit in the end of the pipe-extension tool.



Front Elevation. Section.

FIG. 180*B*.—Method of wiring a switch outlet.

As it was necessary to draw loom-encased, rubber-insulated conductors up through the wireways cut by the pipe-extension tool, a length of carpenter's chalk-line was attached to the end of the bit. It was first tied to the shank of the bit and was then wound around in the spirally twisted portion down to the screw or "worm" at the end of the bit where it was again attached by means of a couple of half hitches. This was done as each vertical wireway was completed with the pipe-extension tool. The cord being attached to the bit end, the pipe-extension tool was withdrawn from the wireway bringing the cord with it. Through the procedure just outlined fishing was avoided and time was saved.

To each of the cords that was drawn into the wireways, cut as above described, was attached a single-braid, rubber-insulated wire, long enough to reach from the nearest outlet on the attic story to the nearest outlet on the second story. The wire was then drawn upward into the wireway and a piece of flexible tubing long enough to encase the entire wire was pushed over it.

Code rules relating to the installation of flexible tubing in partitions are specific. It must be in one continuous piece from support to support or from outlet to outlet. Through the lath and plaster of the partition at the points where the brackets were to be located 2-in. × 2-in. holes were cut. Then through one of the remaining holes, that were bored in the ceiling plate above, a rattan snake (Fig. 138) was pushed and the hook on the end of the snake was fished out at one of the bracket outlet holes in the partition. A piece of iron wire having a hook at one end was used for fishing out the hook of the snake.

To the hook of the rattan snake a length of rubber-insulated wire sufficiently long to reach the nearest support overhead was attached and drawn upward into place. Then flexible conduit or loom was slipped over the wire. A loom-encased conductor was arranged similarly in the other remaining wireway. The loom casing was in each case long enough to reach from the last point of support (the porcelain knob on the joist above) to a point at the outlet 3 in. from the surface of the wall. Fig. 180*B* shows the conductors completely installed.

From each of the split porcelain knobs in the attic floor space (*A* and *A* of Fig. 180*B*) a wire was drawn between the joists to the second-story hall electrolier outlet. One wire was carried down to the switch outlet in the second-story hall and then from this outlet to the electrolier, providing the loop for the single-pole switch for the control of the electrolier lamp. The method of wiring from the attic floor to this hall-lamp-switch outlet was similar to that followed for the bracket outlet shown in Fig. 180*B*.

Where the conductors were installed in floor spaces parallel to beams they were supported on porcelain knobs as *C* and *C*, Fig. 180*C*. The wires were drawn taut so that there would be no slack to make contact with any of the members of the building. The knobs or insulators were spaced at least every 4 1/2 ft. between centers along the joists.

In wiring to the ceiling outlet of the parlor it was necessary to cut a pocket in the second-story floor directly over the outlet. Two wires were connected to the wires coming from the attic at points *B*, Fig. 180*B*, and were drawn into the space between the joists and supported as indicated in Fig. 180*C*. To get the conductors to the center of the room it was necessary to bore through the joists. The conductors were then drawn through the holes which had been previously bushed with porcelain tubes. The holes were bored large enough that the tubes could be inserted in them without force. The holes were given a slight pitch downward so that when the wire was drawn taut it had a tendency to bind the tubes in place.

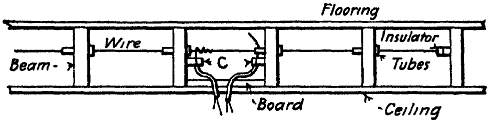


FIG. 180*C*.—Method of connecting a ceiling outlet.

Fig. 180*C* illustrates the method used for connecting a ceiling outlet. The conductors that were passed through the ceiling were connected to the circuit wires and fastened by means of a porcelain insulator at each wire. Flexible tubing, extending from the insulating support to a point 3 in. below the ceiling surface, was slipped on each wire. Before the outlet holes for the tubing were bored in the ceiling, a piece of board or cleat was fastened, as shown, between the joists to support the electrolier.

The other rooms, with the exception of those in the cellar, were wired similarly. The cellar ceiling had not been plastered hence the holes through the joists for the cellar-lamp wires were bored from the cellar, rendering the removal of flooring unnecessary. At all bracket outlets a round block of 7/8-in. board (Fig. 64) was fastened to support the brackets.

INSTALLATIONS WITH A PANEL BOX

298. The wiring of a building large enough to justify the installation of a panel box or distribution center is shown in Fig. 181. (See paragraphs starting with **189** for information relating to distribution centers.) The main difference between this installation and that shown in Fig. 179 is that it has four branch circuits instead of one. The branch circuits are fed from the panel box located in the second-story hall—just about at the center of the building. The house shown in Fig. 181 has brick walls, hence inside partitions and floors were used for runways for the conductors because of the difficulty and expense of carrying conductors along brick walls that are not furred.

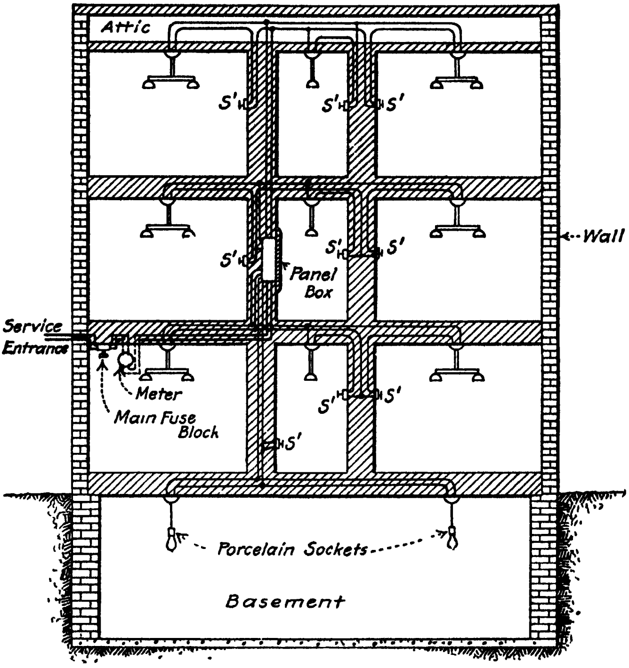
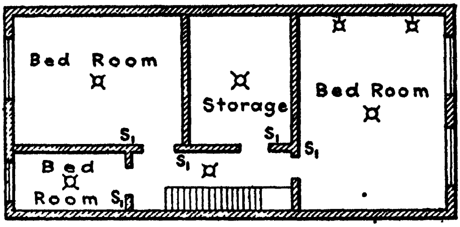
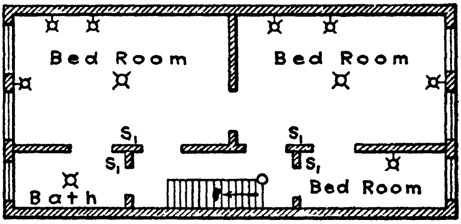


FIG. 181.—Wiring where a panel box is necessary.

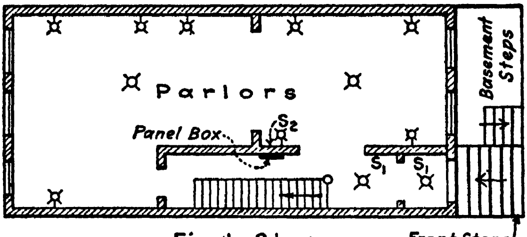
298a. Wiring of a Three-story City Residence with Flexible Steel Armored Cable. Fig. 182 shows the floor plans of a city



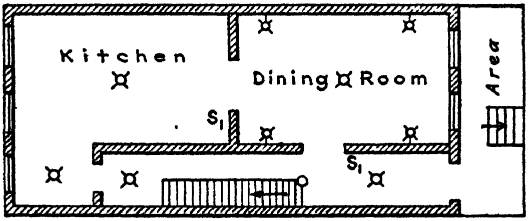
Third Story.



Second Story.



First Story.



Basement.

FIG. 182.—Floor plans of three story and basement brick residence.

residence that was wired throughout with steel armored cable, with the exception of the run from the extrance to the panel box which was in flexible metallic conduit. The front wall is of brick faced with brown stone. The rear and the side, party walls, are of brick. With buildings of this type, adjoining buildings frequently abut. This is the condition with the residence illustrated which accounts for the absence of windows in the side walls. The partitions are lath and plaster throughout. The front and rear walls and the ceilings are furred.

In wiring the building it was necessary to cut chases in the brick party walls for the accommodation of the conductors serving the bracket outlets. The chases were made either 1 in. or 2 in. wide depending on whether one or two armored cables were to be installed in them. In all other cases the armored cables were run within the lath and plaster partitions, between joists or in furring strip spaces and without visible disfigurement to the building. The rooms in which chases were cut in the brick walls were to be redecorated subsequent to the installation of the wiring. In view of this, the most direct, feasible routes between outlets were followed, it being in this case much cheaper in the long run to cut and patch the brick walls than to run the circuit in round-about courses. All damage to woodwork was carefully avoided.

Service for the house was obtained from a pole line. Hence the entrance was arranged, as shown in Fig. 183, by running a line of conduit on the outside of the rear wall of the building from the second story to the cellar. The service conductors could have been run underground from the pole to the house but this would have involved digging in the lawn and securing a permit from the municipality to make an excavation in the street. The meter was located in the cellar near the entrance switch. It was decided to locate the panel box in the partition in the first-story hall as shown in Fig. 182. Furthermore, it was decided to run eight branch circuits from the panel box to serve the outlets.

The first move was to prepare the raceway for and draw in the flexible conduit for the feeder between the meter and the panel box or distribution center. To do this, a pocket was cut in the first-story floor, under the panel box location, close to the partition and from this pocket a hole was bored down through the ceiling plate of the basement partition. Then a mouse was dropped down through the hole and its location at the basement floor was determined by sounding.

The conductor-way through the basement floor was prepared without its being necessary to cut a pocket therein. Near the point within the partition which the sound of the mouse indicated to be the course of the runway, a 1/8-in. twist-drill hole was bored vertically downward through into the cellar. This hole was started very close to the baseboard. At a point 3-in. over toward the center of the partition from the location where the twist drill emerged into the cellar, a large hole was bored vertically upward into and through the cellar ceiling. This hole was large enough to accommodate the feeder conduit between the meter and the distribution center. The hole was bored through the ceiling, the floor plate and into the partition of the basement. In boring such a hole it is necessary to exercise much care to keep the bit within the partition and to prevent it from taking

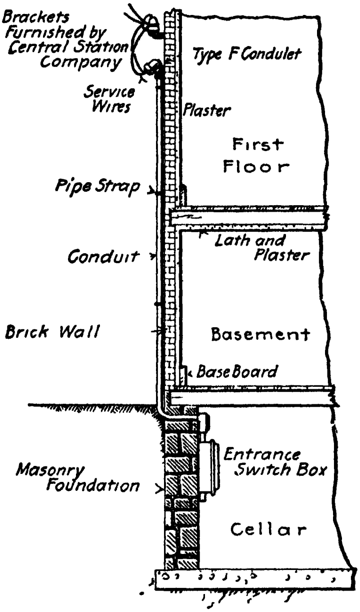


FIG. 183.—Method of making entrance

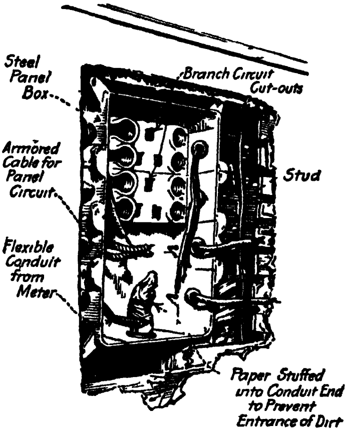

Steel Panel Box
Branch Circuit Cut-outs
Armored Cable for Panel Circuit
Stud
Flexible Conduit from Meter
Paper Stuffed into Conduit End to Prevent Entrance of Dirt

FIG. 184.—Panel box located in wall.

an inclined course and passing out through the lath and plaster into a room above.

Next the hole was cut in the first-story partition for the accommodation of the panel box. The hole was made to extend the entire distance between the studs as shown in Fig. 184. The box was then set as shown in the figure. Then the spaces between the sides and ends of the box and the plaster were concealed by the wooden trim that was subsequently nailed around the box. No armored cable was pulled in until after the box was set. If the cable is pulled in prior to the setting of a box the dangling ends of the cable are likely to break away the plaster around the opening cut for the box.

Eight branch circuits were provided. The panel box used (Fig. 184) is supplied in sections. Each section accommodates two branch blocks. Four branch circuits feed from each side of the box. One circuit serves the third story, two serve the second story, two the first story, one the basement and one the night and hall lamps. There was one spare circuit.

After the panel box had been placed, the flexible conduit for the feeder, from the meter to the box, was drawn into the raceway prepared as previously described. At the panel box a piece of paper was stuffed temporarily into the end of the conduit as shown to prevent the entrance of dirt.

The branch-circuit conductors were then installed. A pocket was previously made in the floor of the first-story hall as hereinbefore described. From this pocket the cables for the basement lights were fished to other pockets and outlets that were located in the floor and ceiling between the basement and the first story. The branch for the cellar was dropped down to that location within partitions, the method of preparing its wireway being essentially the same as that followed in preparing the wireway for the feeder conduit.

The wireways for the branch circuits for the two upper floors were made by cutting a pocket in the floor of the second story at a point directly over the panel box location. From this pocket the necessary number of holes were bored downwardly through the ceiling plate into the partition space. There was a bridge between the studs just above the panel box. Hence it was necessary to use a pipe-extension boring tool (Fig. 114) to cut these holes. The holes required for all of the branch circuits for the two upper floors were bored while the man was working at this location, this procedure being better than to do the boring at a given point for only one circuit at a setting.

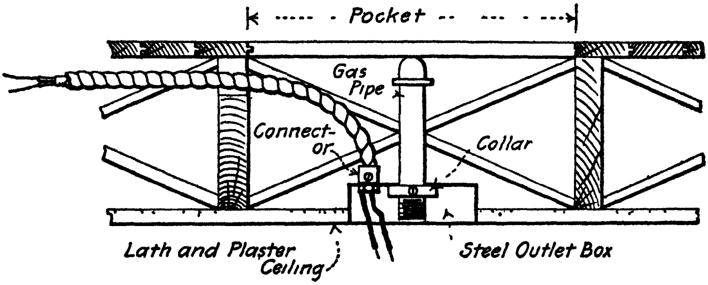


FIG. 185.—Method of installing ceiling outlet box.

At all ceiling outlet locations a hole, the exact diameter of the outlet box for that location, was cut through the lath and plaster. The armored cable was fished from the pockets to these outlet boxes. The building had been piped for gas and the electrolier locations were usually at the same points as the chandelier locations. Hence the ceiling outlet boxes were installed as shown in Fig. 185. After each outlet box had been placed up over the end of the gas pipe, a collar was punched on the end of the pipe and fastened with a set screw as indicated. This collar supported the box.

All wall switches were installed as shown in Fig. 162. In boring from pockets up through floor plates to provide raceways for conductors to switch outlets the doorknob boring tool of Fig. 113 was utilized. For vertical fishing the rattan snake of Fig. 138 was found particularly useful. For electric bracket outlets at existing gas outlets an extra deep outlet box was used as shown in Fig. 186. Each box was

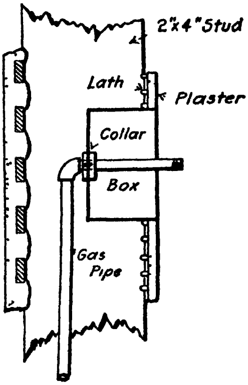


FIG. 186.—Bracket box at combination outlet

secured on the gas-pipe stem with two set-screwed collars, one in front of and the other behind the box.

In the rooms where bracket outlets were installed on the brick side walls it was necessary to channel the wall surface as shown in Figs. 187 and 188. The chases were cut with a cold chisel and hammer. Both of the views show the parlor on the first story. In this room there is a high baseboard at the floor and a plaster cornice at the ceiling. It was considered desirable not to cut these. The runs were installed as indicated in Figs. 187 and 188 both of which show different outlets in the same party wall. The flush wall switch controlling the parlor bracket-lamp circuit was located on the hall partition wall just to the left of the door. The circuit to feed the bracket lamps was carried from this switch outlet over to the bracket outlet located a couple of feet from it. The circuit was then carried down to the floor within the partition and passed in the furring strip space over to a pocket just under the bracket to the right of the parlor door. From this point the cable was looped to the bracket outlet and then carried across the parlor,

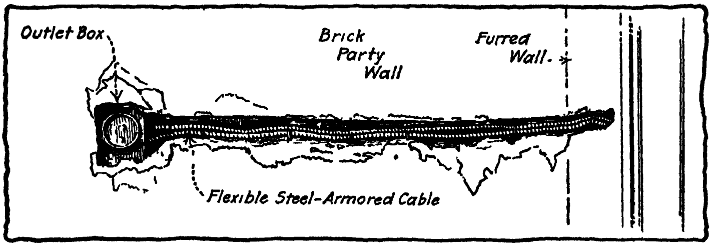


FIG. 187—Conductors and bracket outlet in brick, party wall in front parlor.

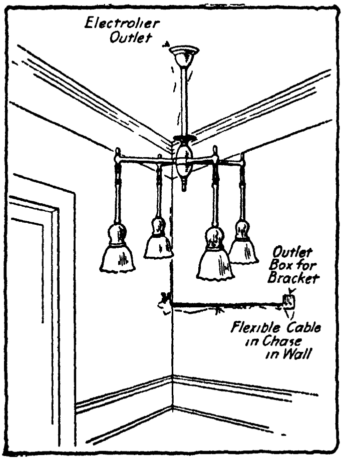


FIG. 188.—Electrolier and wall bracket outlets in front parlor.

in the space between the joists, to a pocket in the upper right-hand corner of the room. From this pocket the cable was looped up in the front wall, in the furring strip space, to a point on a level with the bracket outlets and brought out from the wall and over to the adjacent outlet as shown in Fig. 187. A 2-in. chase was cut in the plaster and brick for the accommodation of the conductors as shown.

From this outlet a leg of the circuit was returned to the front wall (Fig. 187) and down to the pocket in the corner. Then it was carried the length of the room, in the furring strip space, to the partition between the parlors. It was fished up within this partition and over to the bracket outlet in the upper left-hand corner of the room as shown in Fig. 188. It was necessary to cut another 2-in. chase in the brick party wall for this outlet. The bracket-light circuit was terminated at this point. It is always well under conditions such as those just decribed to lay out the circuits so that they will, where possible, terminate on the brick walls. Less cutting of the brick is then necessary than where they are looped on the brick walls.

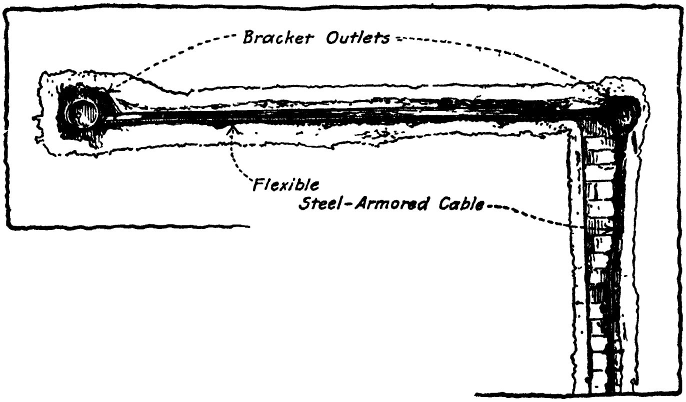


FIG. 189.—Wiring for two bracket outlets in back parlor.

As shown in Fig. 188 no visible cutting was necessary to get the armored cable to the front parlor electrolier. The cable was laid between the joists and in the furring strip space in the ceiling. The outlet box for the electrolier at this point was arranged as shown in Fig. 185.

Fig. 189 shows how two outlets in the back parlor or library were wired. The positions of both of these outlets were fixed by gas outlets already in use. A vertical chase was cut in the party wall to the first gas outlet and then a horizontal one was channeled to the second outlet. The illustration shows an excessive amount of plastering removed. This was cut away by the plasterer, who was to do the replastering, in order to facilitate his work.

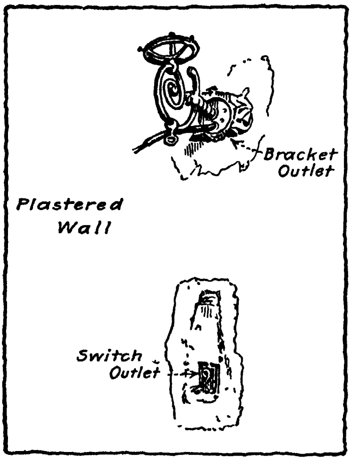


FIG. 190.—Switch and bracket outlet on hall lamp circuit.

In Fig. 190 is shown the outlet for one of the night or hall lamps and switch. A hall lamp was located in the hall of each of three stories of the building and one was installed in the vestibule. The lamps on this circuit may be controlled from any story. One wire of the circuit was run from the switch to the hall lamp outlet on the third story, to the outlet on the second story, and thence to the outlet on the first story. The other wire

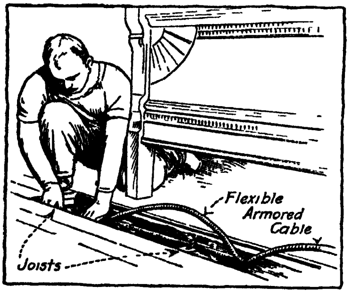


FIG. 191.—Wireman running flexible armored cable in a floor space.

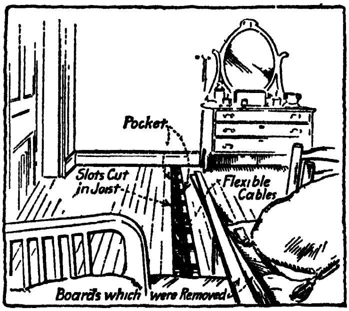


FIG. 192.—Floor boards removed and armored cable in position in one of the bedrooms.

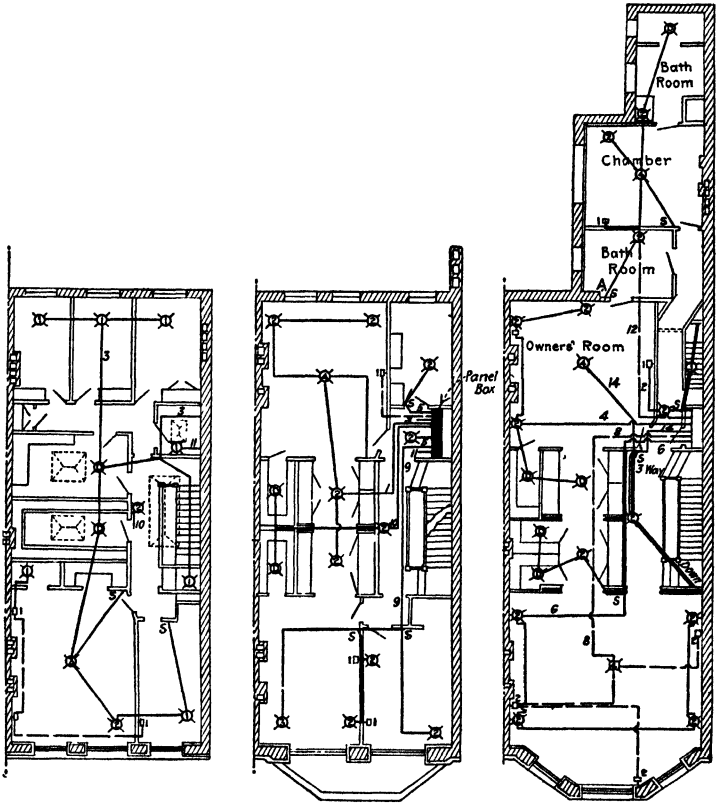
connected each outlet with one side of the branch circuit serving these hall lights. A three-way switch was located on the first and third stories and a four-way switch on the second story. (See Fig. 90 for diagram showing wiring of a hall-light system.) The opposite side of the branch circuit connected to the switch on the first story. Two wires were run from the first switch to the four-way switch on the second story. From this two wires were carried to the three-way switch on the third story.

Fig. 191 shows a wireman installing flexible armored cable in a floor space in the building. The ceiling below the floor shown was furred. The cable was, when its course lay at a right angle to the joists, pulled through the space, occasioned by the placing of the furring strips, between the lower edges of the joists and the lath. A pulling-in line was threaded through the space and the cable was attached to one of its ends. Then the helper pulled on the line, drawing in the cable, while the wireman guided the end of the cable through the raceway as indicated in the picture. Where the course of the cable was parallel to the joists it was drawn into the space between two of them and allowed to rest on the upper side of the lath and plaster ceiling. Fig. 192 shows how the armored cable was installed within the floor of one of the bedrooms.

298b. Wiring of a Five-story-and-basement Residence with Flexible Steel Armored Cable. Figs. 193 and 194 show the floor plans of a New York city residence that is fairly typical of a large number of high-class houses that will be found in the closely built sections in the larger cities. In these sections the buildings are erected without any frontage space between them. The exterior walls are of masonry, usually brick, which renders them difficult propositions for the finished-building wireman. Frequently the walls between adjoining buildings are party walls, that is, the wall is owned jointly by both of the parties whose properties abut. The wall indicated in the illustration by a dashed-double-dotted line is a party wall.

The building shown was wired from top to bottom without visible damage to walls, decorations or trim. There is a total of almost 150 outlets in this residence.

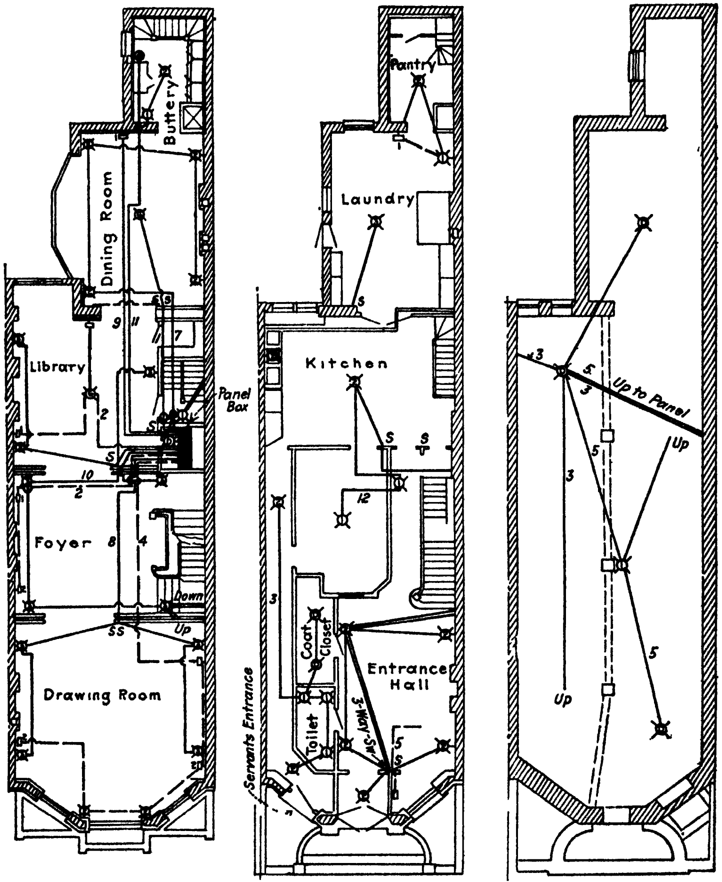
Electricity service is obtained from the underground mains of the local central-station company. Two distribution centers or panel boxes were installed. One, located on the second story, serves the branch circuits for the cellar, the first story and the second story. The other, located on the fourth story, serves the branch circuits on that story and those for the third and fifth stories. The panel boxes were located in closets at the heads of the stairways.



5th Story Plan 4th Story Plan. 3rd Story Plan.

FIG. 193.—Plans of third, fourth and fifth stories.

Furring strips were used in the construction of the building between the lath and the joists and between the lath and the masonry walls. This feature rendered fishing much easier than in a building constructed without furring strips. The diagrams, Figs. 193 and 194, show the numbers assigned, arbitrarily, to the branch circuits. With few exceptions the branch circuits were so laid out that each serves twelve sockets. The standard



2nd Story Plan. 1st Story Plan. Cellar Plan.

FIG. 194.—Plans of cellar and of first and second stories.

symbols of the National Electric Contractors' Association are used in the diagrams.

In installing the base receptacles and switch boxes, holes were cut just large enough to accommodate the boxes. The steel armored conductors were fished from outlet to outlet, from outlets to pockets and from outlets or pockets to switch boxes.

The drawing-room, in which four three-lamp brackets and five two-lamp baseboard receptacles were installed, is shown in Fig. 195. Circuits Nos. 8 and 4 respectively feed these. The bracket lamps are controlled from switches on the jamb of the sliding doors that provide entrance to the room. The baseboard receptacle wiring was carried under the floor. A floor pocket was made under each receptacle and in addition a number of other pockets were cut to facilitate the installation of the armored cable. The illustration shows a snake and a length of armored cable that were pulled from a pocket which was cut to wire the ceiling outlet in the entrance hall of the story below. The bracket outlets in the drawing-room were also wired from the floor below. The outlet holes were cut first, then the conductors to them were fished.

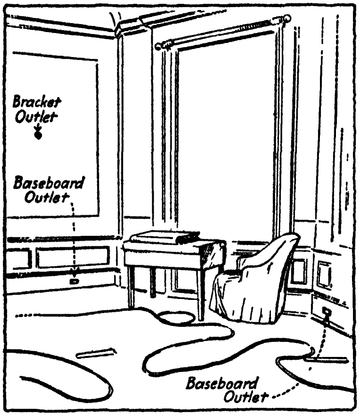


FIG. 195.—Drawing room showing bracket and baseboard outlets.

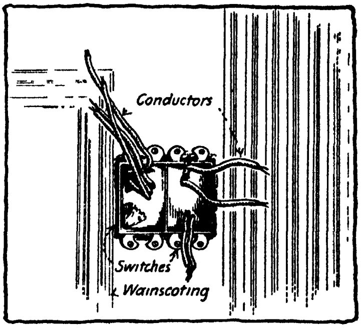


FIG. 196.—Switches mounted in dining room wainscot.

The branch-circuit runs from the panel box to the switches on the second story were drawn under the floor and carried up within the sliding door partition to the switch outlets. From this point the circuits were carried down to the space under the floor, then between the lath and joists, in the space provided by the furring strips, over to a fishing pocket. From the fishing pocket they were fished to other pockets, one of which was made directly under each bracket outlet. Between each bracket outlet and the pocket located directly under it the conductors were fished up within the partition.

This drawing-room was elaborately decorated but the only defacements necessary were those made by the floor pockets. These were practically invisible after the job had been completed. All of the floor pockets were made as small as possible. The floors were cut and the pieces were removed and replaced by a skillful carpenter. The fixture canopies covered the edges of the holes that were cut for the outlet boxes and the outlet boxes themselves. The plates of the baseboard receptacles covered the edges of the holes made for these.

In the dining-room the switches were mounted in the hardwood wainscot as shown in Fig. 196. The bracket outlets for this room are served by circuit No. 7. The ceiling outlets are fed by circuit No. 1, which also supplies energy to outlets in the kitchen on the story below.

A special circuit, No. 11, was run from the panel box to an outlet in the pantry for serving heating apparatus. The baseboard receptacles in the foyer hall were connected to circuit No. 2. Brackets, baseboard receptacles and floor receptacles in the library were also connected to branch circuit No. 2. Circuit No. 6 feeds the baseboard and floor receptacles in the library. Circuit No. 9 runs to the pantry back of the dining-room and thence down to the bracket in the kitchen on the story below and to a ceiling outlet in the passage in the rear of the kitchen; a base receptacle in the dining-room and another in the kitchen are also connected to this circuit. In the entrance hall, the brackets are connected to circuit No. 5 and the brackets in the foyer hall are fed from No. 10. A total of twelve circuits feeds from the distribution center or panel box on the second story..

Fourteen branch circuits feed from the panel box on the fourth story. One circuit is a spare. There was nothing in connection with the wiring of the three upper stories that differed radically from the procedure followed for the others. The bath room in the rear of the owner's room has a tile wainscot and a tile floor. The roof (there is no attic) is directly over this room, hence it was necessary to fish up from the switch outlet *A*, Fig. 193, over the bath room ceiling and down to the two-lamp bracket outlet located on the opposite wall. The circuits in the bedroom and the bath room at the extreme rear of the third story were fished similarly. There was no hanging ceiling and, obviously, the roof could not be cut. Switch *A* was actually located to the right of the bath room door instead of at its left as shown in the illustration. Therefore the fish-wire course was at a right angle to the joists from the switch to the bracket outlet. The setting—the plate being removed—of switch *A* is shown in Fig. 197.

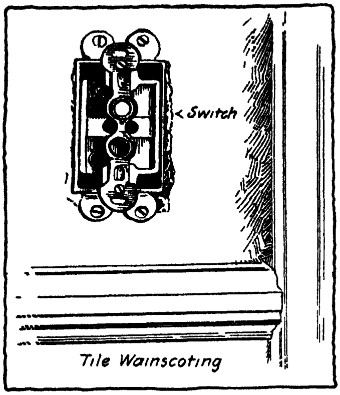


FIG. 197.—Switch mounting in bath room

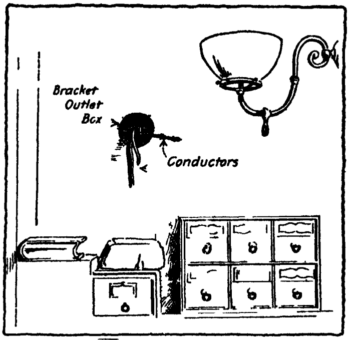


FIG. 198 —Bracket outlet box in position in owner's bedroom.

Fig. 198 shows how the wall in the owner's room was cut and a bracket outlet box installed. The outlet hole was made very carefully, exactly the diameter of the box, and the result was that it fitted snugly. In Fig. 199 is shown a view of the front bedroom on the fifth story. There is an outlet at the chandelier and

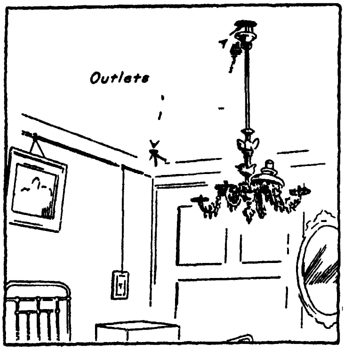


FIG. 199.—Ceiling outlets in bedroom.

a two-lamp outlet directly over where a dressing table is normally located. Neither ceiling nor side walls were damaged in running the conductors to these outlets.

MISCELLANEOUS INSTALLATIONS

299. An installation where rigid conduit was installed on a residence exterior (see Fig. 200 and Par. **130**) was described by V. Spath in *Electrical Review and Western Electrician* of Feb. 15, 1913. Metallic conduit wiring was compulsory but neither flexible steel armored cable or flexible metallic conductor was available, hence rigid conduit was used for the entire job. The building had two stories and an attic and had, with the exception of the attic, double floors throughout. It was not considered advisable to disturb any of these floors.

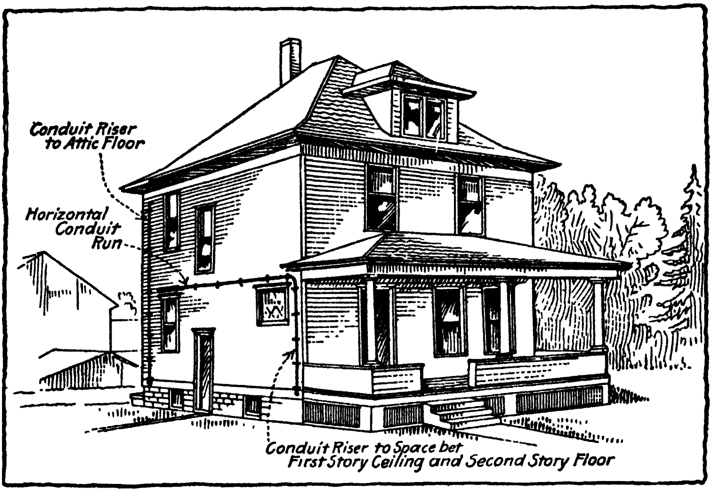

Conduit Riser to Attic Floor
Horizontal Conduit Run
Conduit Riser to Space bet First Story Ceiling and Second Story Floor

FIG. 200.—Conduit runs supported on the outside of a building.

A 1/2-in. galvanized conduit was installed along the side of the house in line with the second-floor joists. For lateral connections 1/2-in. right or left, tee and ell, condulets were utilized and from these fittings conduit lines were run to the ceiling outlets in the spaces between the joists. At the ceiling outlets, most of which were combination gas and electric, galvanized street ells and 1/2-in. outlet plates which were fastened to the joists were used. The center outlet of each plate was used for the gas pipe. The galvanized ell was fastened in one of the other outlets with a lock-nut and a bushing.

Conduit risers were then run from the basement up the side of the building along vertical gutter spouts or in angles in the wall and were connected to the horizontal runs described above. The risers were not conspicuous due to the locations selected for their installation. The risers to the switches in the first-story rooms were concealed in partitions and terminated in standard switch boxes and fittings. The switch-boxes were all installed on wainscoting or on suitable blocks (see Fig. 65) so that a neat installation of the flush switches resulted. The service conductors were carried in conduit to the old service cabinet, which was located in the basement and was in good condition.

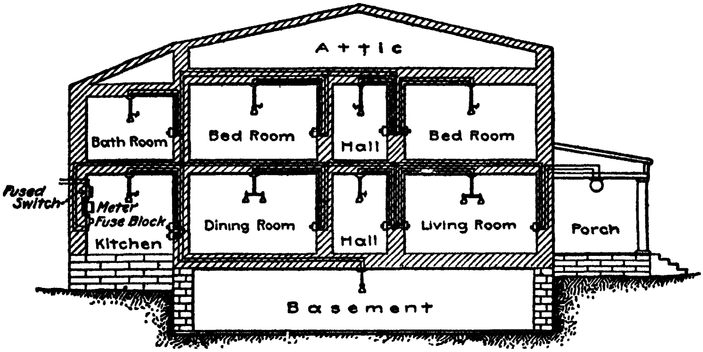


FIG. 201.—Building wired for double-pole switches.

In wiring to the ceiling and wall outlets on the second floor, boards were removed from the attic floor and the circuits were fished to the outlets. Then a conduit riser to serve the second floor was installed in a space by the chimney where it was concealed by partitions. An improved terminal fitting was used on the end of the conduit.

There were two sets of three-way switches and each set had a four-way intermediate switch providing three-location control for the lamps on these circuits. There were also an electrolier switch for the dining-room lamps and several single-pole switches at different locations in the house. A special circuit was provided in the kitchen for an electric iron. This was fed through a double-pole flush switch, pilot light and a flush receptacle.

A careful painting of the conduit on the outside of the house rendered it altogether inconspicuous. It would not be discerned by the ordinary passer-by. All holes in the wall, where the conduit entered the house, were packed with white lead and the screwed joints in the exposed conduit were carefully leaded.

300. The method of wiring a building with double-pole switches is shown in Fig. 201. Double-pole switches are required for all lamp outlets in certain communities. In Pittsburgh the municipal rules require that each room must have an independent switch located at the most used entrance to the room and that where there is a gas outlet at the point where the electrolier is to be located, the switch must be double pole.

CHAPTER XI

FIXTURES

FIXTURES FOR FINISHED-BUILDING INSTALLATIONS

301. Fixtures for Finished-building Wiring Installations. It has been the experience of most central stations that some provision must be made whereby sightly electric, and combination gas and electric, lighting fixtures can be furnished to consumers at low cost. Either the central station may sell the fixtures direct to the consumers or arrangements may be made with contractors and dealers to retail fixtures of certain styles—leaders—to the consumers at attractive prices. The general opinion seems to be that, in this matter as in the other matters of policy in finished-building wiring campaigns, it is best, where possible, for the central station, the contractors and dealers to all work together.

It is an undisputed fact that many people will decline to have their houses wired unless they can obtain good-looking fixtures at reasonable prices. The central station must make it its business to see that they can.

In practically every case, the fixtures are ordered at the same time as is the wiring and the price of the fixtures is added to the wiring price, giving the price of the job—the figure in which the consumer is interested. Usually the central station carries the fixture account and the consumer pays the central station for both fixtures and wiring, either on a cash or an installment basis, even though the fixtures are purchased through a contractor or dealer.

Sometimes central stations purchase a considerable quantity of fixtures of a certain style and retail them direct to the consumer, provided they are to be used for finished-building installations. In such cases it is possible to make very low prices. (See Fig. 202, illustrating and pricing—the price to the consumer—fixtures

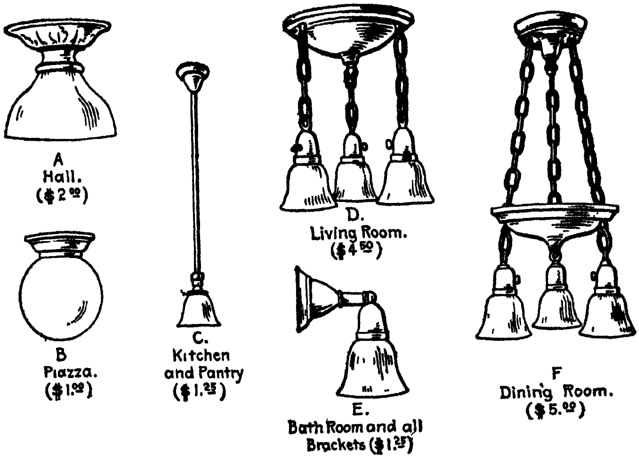


FIG. 202.—Fixtures used in Boston house wiring campaign. (Prices are those to the consumer.)

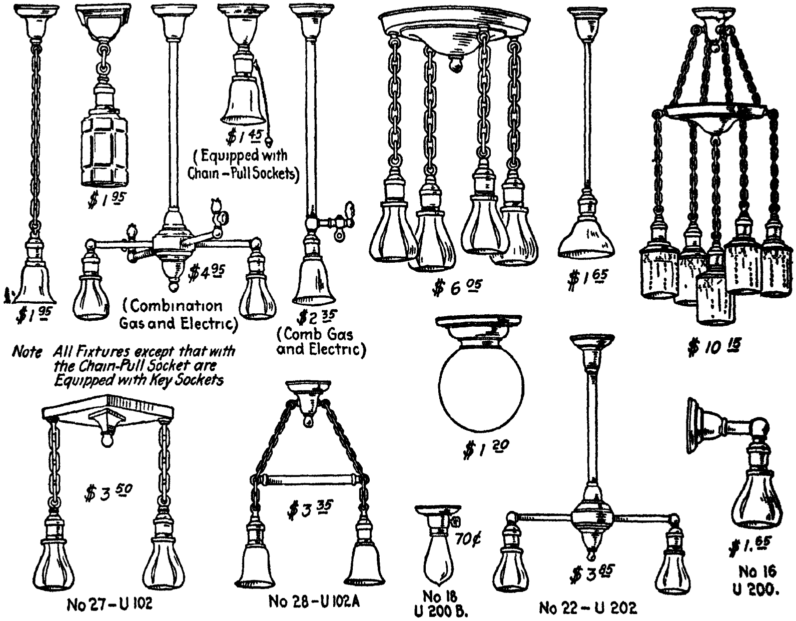
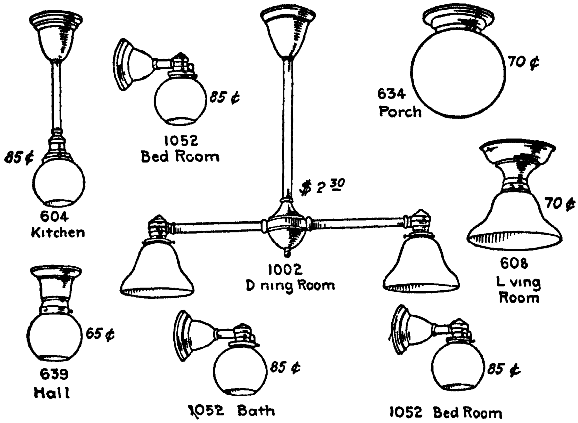
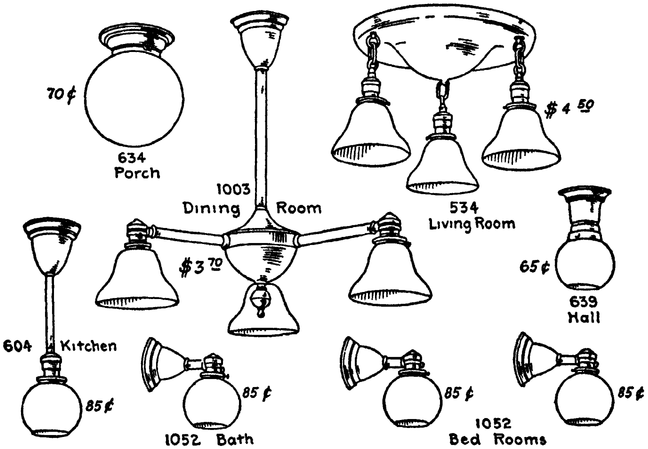


FIG. 203.—Fixtures sold in finished-building wiring campaign by the Union Electric Light & Power Company, of St. Louis, Mo. (Prices are those to the consumer.)



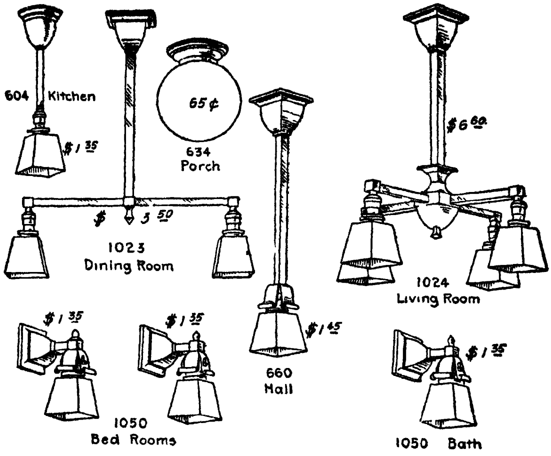
RESIDENCE FIXTURE SET A



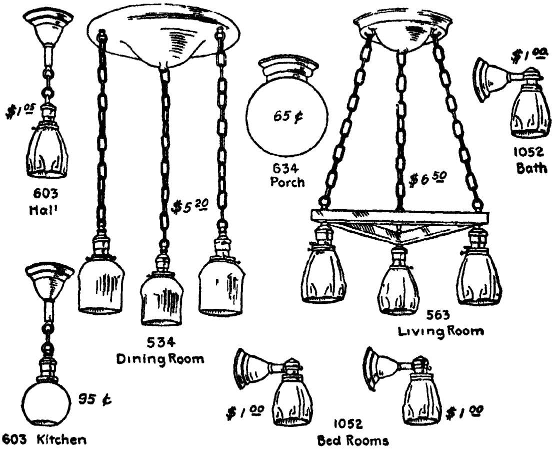
RESIDENCE FIXTURE SET B.

Note Prices Shown are Approximate for Fixtures when Purchased in Lots of 10 or more and are for Fixtures Wired Complete with Keyless Sockets, Shade-Holders and Glassware For Key-Sockets add 5 ¢ per Socket

FIG 204 —Sets of low-priced residence fixtures manufactured by the Federal Sign System.



RESIDENCE FIXTURE SET D



RESIDENCE FIXTURE SET F

Note *Prices Shown are Approximate for Fixtures when Purchased in Lots of 10 or more and are for Fixtures Wired Complete with Keyless Sockets, Shade-Holders and Glassware. For Key-Sockets add 5 ¢ per Socket*

FIG. 205.—Sets of low-priced residence fixtures manufactured by the Federal Sign System.

used in the Boston, Mass., campaign.) It is not usually feasible for the smaller central stations to do this. With them the practice is to arrange with some fixture manufacturer to furnish the fixtures as required at the lowest possible prices. Then samples of the different fixtures to be exploited are exhibited and orders are taken from these samples. Under this arrangement it is not necessary for the central station to carry an extensive stock.

Fixtures can be, and are, sold from illustrations and catalogues. However, the most effective method is to exhibit sample fixtures either in a neat window display or show room or, preferably, in rooms fitted and furnished like the rooms in a house. Fig. 203 shows the fixtures sold in connection with a successful finished-building wiring campaign in St. Louis. The prices given are those to the consumer. Illustrated in Figs. 204 and 205 are fixtures typical of the line manufactured by the Federal Sign System, particularly for use in connection with finished-building wiring campaigns. The prices shown are those allowed to central stations and dealers.

302. Styles of Fixtures to Feature. It does not pay to feature too many styles of fixtures in finished-building wiring campaigns. Probably it is the best plan to feature only one or at the most two. In addition, where gas is used extensively, a line of combination fixtures should be available because there is a certain class of consumers that still believe that gas should be at hand for emergencies. In the Boston campaign, only one style of fixtures (Fig. 202) was exploited and with splendid results. In the St. Louis campaign, a couple of styles (see Fig. 203) were sold at low prices. If more than a couple of styles are shown the consumer may become confused and hesitate to ask some one's opinion. This causes delay and costs money. It really makes little difference in the average finished building what style of fixture is used provided it is neat and substantial. The most important advantage of using only a style or two is that the central station or dealer can get very low quantity prices on a considerable number of fixtures all of the same style. Where a prospective customer is encountered who desires fixtures of some particular style or design and is willing to pay for them, he can be referred to a fixture house that will furnish anything that is required.

INDEX

A

Advertising a premium campaign 40
  blind 21
  campaign, example of a successful 22
  circulars and folders. . 15
  circular letter. . . . 11
  by contractors' associations 20
  cost of a wiring campaign. 7
  different methods of 7
  Duquesne Electric Light Co., Pittsburgh, Pa. 21
  electrical page 19
  electric sign 19
  enclosures with letters . 98
  handbills 18
  in classified columns .. 21
  in Kansas City, Mo., illuminated sign 13
  moving pictures 99
  newspaper 9, 99
  of the Byllesby Co. 21
  posters and billboards. . 13
  reading notice 24
  relative values of various methods 8
  street car card 12
  street car 99
  to selling, relation of 92
  window display 15, 99
  in wiring campaigns 6
Agreement, typical wiring ... 89
Angling rod for wire fishing. . 193
Animals as assistants in fishing 183
Apartment wiring 133
Application form for electric wiring 43
  of exploring lamp in fishing 179
  of metallic conduit and flexible steel armored conductor 114
Applications of Kuhlo wire... 142
Appendix to commercial section 85
Armored cable in brick wall. . 240
  conductor, flexible steel. . 113
Atlantic Coast, percentage of houses wired 1
Austria, the "plaster hose" system in 137
Average prices for wiring finished frame buildings 63

B

Baltimore, Consolidated Gas, Electric Light and Power Co. lamp-outlet, unit price schedule 69
Bare concentric wire (Kuhlo wire) 137
Bargain feature in wiring campaigns 7
Base blocks for fixtures and switches 128
Baseboard, method of running conductors from floor pocket to partition above without disturbing 212

Baseboard outlets, wiring to.. 246
 tools for removing....... 169
Basis of estimating house-wiring............. 87
Bath room switch mounting in................. 248
Bergmann Tube system...... 136
Billboard and poster advertising.............. 13
Bit, exploring 182
 holder extension......... 177
 steel fish................ 178
Blind advertising............ 21
Board, how to avoid the splitting of when driving a nail in............ 168
Boards, removal of floor...... 159
Booklet "Electric Service in The Home"........ 16
Boring a ceiling, device to catch chips when.. . 158
 and boring tools... 170
 floor and ceiling plates with ratchet drill.... 172
 holes in joists........... 171
  from outlets and pockets, tool for......... 171
 plaster-of-Paris canopies and molding... 170
 through joists, pipe extension boring tool for.............. . 174
 tool, manipulation of the pipe-extension...... 175
  pipe-extension........ 173
  size of holes to be bored with............... 176
  turning with a pipe wrench............ 176
Boston, Mass. campaign..... 45
  circular letters in...... 12
  fixtures used in....... 256
 schedule of prices for wiring............. 79
Box, bracket outlet, in partition.............. 116
Box switch, installation of rigid conduit........ 106
Boxes, switch, cutting holes for................ 169
Bracket box for steel armored cable or flexible conduit................ 114
 knob and tube method of wiring............. 127
 outlet box in partition... 116
  installation of......... 107
 wiring, knob and tube... 124
Branch block installation..... 221
 circuits................ 146
  determination of number of.............. 146
  distribution centers and panel boxes......... 146
Brick, drills for piercing...... 213
 or masonry walls, conductors in......... 122
 wall, running conductors to an outlet in...... 208
  wiring to outlets in.... 241
Bridge in wall, to carry conductors past a...... 203
Bridging, running wires past between joists...... 125
Brooklyn, N. Y., campaign of Edison Electric Illuminating Co....... 46
 prices of Edison Electric Illuminating Co. for wiring............. 76
Building construction........ 150
 wired for double-pole switches............ 250
Buildings, card record of unwired.............. 26
 finished business yet to be obtained in......... 2
 new, per thousand population.............. 5
 small, average income from 3
Burglar circuit wiring in finished buildings...... 154

Burglar emergency switch. 153
Business already obtained.... 1
  yet to be obtained in finished buildings...... 2
Butler, Pa., West Penn Traction Co. campaign... 52
Byllesby campaign at Louisville, Ky........... 42
  Co., advertising methods of................. 21
  Company Campaigns.... 39

C

Cable, wiring of a five-story-and-basement residence with flexible steel armored.. . 243
Calculation of wire sizes..... 146
Campaign, advertising cost of a wiring............ 7
  example of a successful. 22
  Boston, Mass........... 45
  Butler, Pa............. 52
  direct by mail.......... 96
  Edison Electric Illuminating Company of Brooklyn, N. Y..... 46
  free fixtures as a feature of..... 36
  Harrisburg, Pa.......... 50
  house-wiring for Dawson, Ohio............... 86
  Kansas City, Mo.... .. 49
  Louisville, Ky........ .. 50
    H. M. Byllesby Co... 42
  Marshalltown, Iowa..... 52
  Minneapolis, H. M. Byllesby Co........... 40
  Muncie, Ind............ 51
  Mt. Vernon, Ill......... 53
  Pittsburgh, Pa.......... 47
  South Bend, Ind........ 50
  Toledo, Ohio........... 50
  typical form of.......... 93
  Union Electric Light and Power Co., St. Louis. 44
Campaigns, advertising finished-building wiring. 6
  examples of finished-building wiring..... 39
  future.................. 93
  the bargain feature in... 7
Canopies, boring plaster of Paris.............. 170
Canvass, personal........... 19
Car, cards................... 12
Card, example of a soliciting. 27
  record of unwired buildings................ 26
Carrying conductors, around or through a sill..... 205
Cash premiums as a stimulant to solicitors........ 31
Ceiling, fishing conductors from............... 194
  forcing conductors around coved portions of.... 198
  installing outlet box for flexible metallic conduit in furred....... 117
  method of locating center of................. 214
  or center outlets, fishing to................. 209
  outlet box, method of installing............ 239
    method of connecting. 233
    under parquetry border. 210
    wiring from, to a partition outlet.......... 212
  outlets, cost of standard. 67
    knob and tube method. 126
  to side-wall outlet, fishing from........... 196
Center of ceiling, method of locating............ 214
  outlets, wiring conductors to................. 209
Centers of distribution, costs and list prices of services, entrances and runs to............ 66

Chain for fishing............ 185
Charges on interior wiring, overhead and general expense............ 61
Charging flat-rate method of. 37
  small consumer, flat-rate basis............... 4
Chicago wiring rules......... 61
Chisels for removing floor boards 159
Cinder-filled floors, wiring buildings with...... 215
Circuit, master switch....... 153
Circuits, emergency or burglar............. . 154
  three-way and emergency. 153
Circular includes contract, Union Electric Company's............. 16
  letter, sample........... 96
  letters.................. 11
    in Boston, Mass. campaign.............. 12
  loom in finished buildings, use of............. 123
Circulars and folders......... 15
Cities, development in....... 5
Citizens Gas & Electric Light Co., Mt. Vernon, Ill. campaign........ . 53
Classification of buildings for estimating on Unit or "Standardized" basis.............. 60
  of finished building wiring methods........... 101
Cleats to support replaced floor boards........ 166
Cloth, drop................. 157
Combination of rigid and flexible conduit........ 119
  wooden molding and flexible tubing wiring... 133
Compilation of estimates..... 54
Concealed knob and tube wiring, prices for....... 83
Concentric wiring (Kuhlo wire).............. 137
Conductor, flexible steel armored............. 113
Conductors around a sill, carrying.............. 205
    coved portions of ceiling.............. .. 198
  carried concealed within molding............ 132
  fished from ceiling....... 194
  from floor pocket to partition above, method of running 212
    to floor, knob and tube method of carrying.. 125
  in conduit installations. 103
  laid on furring strips, fishing.............. .. 199
  past a bridge in wall.. . 203
  routes for.......... .. . 145
  to an outlet in a brick wall, running....... 208
Conduit, combination of rigid and flexible... 119
  device for pulling flexible. 118
  exposed, for finished-building wiring . . 110
    on building exterior. 111
    to moisture, combination of rigid and flexible 120
  for feeder............... 104
  in brick or masonry walls. 122
  in furred walls, running flexible............. 119
  installation of switch box for flexible.......... 116
    of wall bracket box for steel armored cable or flexible.......... 114
    rigid-and-flexible... .. 121
  installations............ 103
  installed on building exterior, rigid......... 110
  iron, panel boxes for..... 150

Conduit lines in elevator shaft. 109
  metallic flexible, must not be subjected to moisture. 118
  riser in building of several stories. 110
  runs on outside of building. 249
  slotting joists for. 103
  splicing flexible. 114
  switch box, installation of. 106
  use flexible instead of bending rigid. 120
  vertical, can serve two outlets. 123
  wiring. 102
    flexible metallic. 113
    rigid. 102
  work, installing panel box. 105
Conduits, joining rigid vertical. 107
  substitution of one rigid for several flexible. 121
Connecting a ceiling outlet. 233
Connections, soldering. 213
Connectors for armored cable. 115
Consolidated Gas, Electric Light and Power Co., Baltimore, Md., wiring prices. 59
Construction, building. 150
  frame buildings. 151
  of a panel-box. 147
  of flexible metallic conduit. 114
Contract and specification. 88
  finished-building wiring. 17
  Union Electric Company circular. 16
Contractors' Associations, advertising by. 20
Contractors, how one central station co-operates with the. 34
Contractors, relations with. 33
Contracts, distribution of. 91
Controlled flat-rate method of charging. 37
Controller, flat-rate. 37
Co-operation between central stations and contractors. 34
Cottages, charges for wiring furnishing lamps and fixtures, Mobile, Ala. 78
Cost data in 1913 National Electric Light Association report. 60
  for installing switches, labor. 62
  of a wiring campaign, advertising. 7
  of cutting hardwood and Parquetry floors. 62
    hardwood floors. 62
  of fixtures. 253
  of metal molding installations. 130
  of standard ceiling outlets. 67
  of wiring, effect of Municipal rules on. 61
    as affected by National electrical code rules. 61
    buildings in Europe. 84
Costs and list prices of extras. 68
    of outlets. 67
    of services, entrances and runs to centers of distribution. 66
  and prices of finished-building wiring. 54
  N. E. L. A. 60
Cottages, price of flexible metallic conduit wiring. 75
Current-lighting devices. 37
Customers per capita. 1
  per thousand population. 5
Customer, small possibilities of. 3

Cutting a small pocket...... 166
  quick method of...... 167
  holes for round outlet boxes.............. 170
  outlet holes............. 169
  wall paper for making fishing hole......... 204

D

Dawson, Ohio, campaign in.. 85
"Dead" molding............ 134
Denver wiring rules......... 61
Determination of number of branch circuits...... 146
Development in different cities, table of...... 5
Dimensions of rigid conduit and conduit fittings. 102
  of steel fish wire......... 186
Direct-by-mail campaign..... 96
Dirt catcher, cone-shaped reflector as a.. 159
  inverted umbrella as... 158
  -catching device when boring a ceiling... . 158
Display advertising, window.. 15
  cards in Manchester, N. H. campaign........ 14
Districts, solicitation, division of a community into. 26
Distribution cabinet and junction boxes in a combination rigid-and-flexible conduit installation........... 121
  center, panel-box........ 147
    selection of point for.. 145
    wiring to............. 234
  centers and panel boxes.. 146
  of contracts............ 91
Division of a community into solicitation districts. 26
Door-knob boring tool....... 171
Dortmund, rental of fixtures in................. 37
Double-pole switches, wiring a building with..... 251
Dowel joint for pipe-extension boring tool......... 175
Drills for boring floor and ceiling plates, ratchet... 172
  for piercing brick........ 213
Drop cloth..... 157
Duquesne Electric Light Co. advertising......... 21
  Light Co. of Pittsburgh, advertising......... 22
  Electric Light Co., Pittsburgh campaign..... 47

E

Edison Electrical Illuminating Co., Brooklyn, N. Y., campaign of........ 46
Educational campaign, house-wiring campaign preceded by an........ 6
Electrical page advertising... 19
Electric bell indicator in wire fishing............. 198
  exploring lamps......... 182
  signs.................... 19
Electroliers fed from attic, supporting.......... 107
Electrolier installation with circular loom wiring. 126
Elevator shafts, installing conduit lines in........ 109
Emergency circuits for three-wire system installations............... 156
  three-way and........ 153
  or burglar circuit wiring. 154
Encasing conductors with loom............... 123
England, finished-building wiring in........... 142
Entrance, meter and distribution-center locations. 145
  method of making into basement........... 237

Entrance wires, installation of. 145
Entrances and runs, costs and list prices.......... 66
Estimate, and example of an itemized........... 64
  sheet.................. 58
Estimates and their compilation............... 54
Estimating and prices........ 35
  blank and its use........ 28
  convenient form for rough. 54
  form, sample of......... 55
  house-wiring, basis of.... 87
  method of.............. 92
  on a unit or "standardized" basis........ 60
Estimator, personal requirements of the........ 29
  solicitors and salesman-solicitors......... 25
Estimators employed in soliciting business........ 29
  work in a wiring campaign.............. 29
Europe, cost of wiring buildings............... 84
  methods of wiring in..... 135
  rental of fixtures in...... 36
Examples of campaigns...... 39
  of installations.......... 217
Excess-indicators............ 37
Exploring bit.............. 182
  lamp in fishing......... 179
  lamps, home-made...... 179
    electric.............. 182
  of partition interiors..... 178
  partition interiors....... 181
  wiring spaces with mirror and flash light...... 180
Exposed conduit for finished-building wiring...... 110
  wiring for finished buildings............... 101
Extension-bit holder......... 176
    homemade........... 177
  boring tool, pipe........ 173
Extension plug mounted in a baseboard 207
Extensions to existing installations with molding . 133
Exteriors, rigid conduit installed on building.. 110
Extras, costs and list prices of. 68

F

Faraday Electrical Association of Chicago....... .. 20
Federal Electric Co. fixtures. 254
Feeder, conduit for.......... 104
Finished-building salesmen... 25
    wiring at Milan, Italy. 136
      campaign advertising, the desideratum of........... 6
      estimators work in a. 29
      campaigns, advertising in.......... 6
        examples of....... 39
      classification........ 101
      contract, sample.... 17
      exposed............ 101
      in England......... 142
      in Europe.......... 135
      installations, fixtures for.............. 252
      jobs, profits and list prices for......... 61
      methods of determining costs and prices 54
      miscellaneous methods.............. 212
      neatness........... 157
      prices for knob and tube............. 83
      soldering connections. 213
      solicitor, qualifications of.......... 25
      use of flexible tubing or circular loom in. 123

Finished buildings, business yet to be obtained in. 2
- rigid conduit installations 102

Fish bit, steel 178

Fishing and fishing devices 183
- angling rod for wire 193
- animals as assistants in 183
- chain for 185
- conductors from ceiling 194
  - laid on furring strips 199
- electric bell indicator 198
- from ceiling to side-wall outlet 196
- hole, cutting, without disfiguring wall paper 204
- illumination and exploring of partition interiors 178
- knob on end of snake for 187
- magnetized steel hook for 189
- pull socket chain for 185
- to ceiling or center outlets 209
- tool, steel hook 189
- wire, iron pipe as guide for 197
  - or snake 186
  - weighted end 187
- wires through holes with extension bit 178
- with two hooked snakes 196
- work of helper in 187

Fittings for Kuhlo wire 141

Five-story-and-basement residence, wiring with flexible steel armored cable 243

Fixture served through molding, installing a 132
- wires, pulling past a right angle 195

Fixtures and lamps, wiring, policy 87
- and switches, base blocks for 128

Fixtures, electric 252
- for finished-building wiring installations 252
- free as a feature of campaign 36
- in Europe, rental of 36
- policy in regard to 35
- rental of, in Europe 36
- solicitors should carry pictures and prices of 36
- to feature, styles of 256
- typical 253

Flat-price for outlets 59
- per installation 58
- -rate basis of charging small consumer 4
  - controller 37
  - method of charging 37

Flexible conduit bracket outlet box in partition 116
- combination of rigid and 119
- device for pulling 118
- splicing 114
- wiring a building with 119
- cord on glass button construction 135
- metallic conduit instead of bending rigid conduit 120
  - not to be subjected to moisture 118
  - wiring 113
    - for finished buildings 113
    - for medium-grade finished buildings 74
- steel armored cable, wiring of a five-story-and-basement residence with 243
  - cable, wiring a three-story city residence 234
  - conductor or steel cable 113
- tubing and molding wiring, combination 133

- Flexible tubing at electrolier. 126
  - at outlets............ 124
  - or circular loom in finished-building wiring................ 123
- Floor and ceiling plates, ratchet drill for boring. 172
  - boards, cleats for replaced. 166
    - removal of........... 159
    - removed by sawing off tongue........... 164
      - in a continuous line 228
    - removing, with scraper and hammer........ 163
  - saw for removing floor boards............. 159
  - space, armored cable in.. 242
- Floors, cost of cutting hardwood and parquetry. 62
- Flooring, length to be removed 165
  - saw for finished-building wiremen.......... .. 160
  - taking up finely finished. 164
    - up soft-wood......... 162
- Flush switch, installing. 208
- Folders and circulars........ 15
- Follow-up by salesmen, personal............... 98
- Forcing conductors around coved portions of ceiling............. 198
- Form for rough estimating... 54
  - letters................. 94
  - of application for electric wiring............. 43
  - of campaign............ 93
  - of circular letters........ 98
  - preliminary information. 56
- Forms of wooden molding.... 131
- Frame building, small, example of wiring........ 228
  - buildings............... 150
    - average prices for wiring finished......... 63
    - wiring with knob and tube method........ 217
- Framing of wooden buildings. 150
- Furred ceiling, outlet box in.. 117
  - walls, running flexible metallic conduit or armored cable in...... 119
- Furring strips............... 152
  - fishing conductors laid on................ 199

G

- General expense charges on interior wiring, overhead and. 61
- Germany, methods of solicitation in............. 30
  - Strasburg, customers per 1000 population..... 1
  - wiring in............... 136
- Glass button construction, flexible cord on..... 135
- Group method of securing new business............ 48
- Growth, rate of............. 2
- Guide for fishing wire, iron pipe as............. 197

H

- Hall lighting by three-way switch............. 153
- Handbill advertising....... 18
- Hardwood floors, cost of cutting............... 62
  - cost of cutting parquetry and............ 62
- Harrisburg, Pa. campaign.... 50
- Helper's work in wire fishing. 187
- Holder for extension-bit...... 177
- Holes, cutting outlet......... 169
  - for round outlets boxes in plastered surfaces, cutting............. 170
  - in joists, boring......... 171
  - sizes of, to be bored with pipe-extension tool.. 176

Home-made exploring lamps. 179
Hook for fishing............. 291
  magnetized........... 189
Hooked snakes, fishing with two................ 196
Houses wired, not using current................ 93
  percentage of........ 1
House-wiring, basis of estimating................ 87
  campaign, specifications for a.............. 85

I

Illuminated sign advertising in Kansas City..... 13
Illumination and exploring of partition interiors while fishing........ 178
Incandescent lamps for finished-building wiring installations........ 37
Income, average from small buildings........... 3
Indicators, excess........... 37
Information sheet........... 57
  preliminary........... 56
Installation, exposed conduit. 111
  flat-price per............ 58
  lighting................ 91
  of a fixture served through molding............ 132
  of a wall bracket box for steel armored cable.. 114
  of bracket outlet box.... 107
  of electrolier with circular loom wiring........ 126
  of entrance wire.... 145
  of Kuhlo wire........... 138
  of outlet box in furred ceiling............. 117
  of panel box in rigid conduit work.......... 105
  of panel box or distribution center......... 234
Installation of rigid conduit switch box.......... 106
  of switch box........... 116
  of the panel-box....... .. 149
  of wooden molding...... 131
  three-way switch circuits. 153
  with rigid conduit on residence exterior....... 249
Installations, conduit........ 103
  examples of............. 217
  fixtures for finished-building wiring.......... 252
  miscellaneous............ 249
  planning................ 144
  without panel boxes..... 217
Installing a flush switch...... 208
  a wall switch box, method of 208
  conduit lines in finished building elevator shafts.............. 109
  flexible conduits in furred walls.............. 119
  outlet box, method of.... 239
  rigid conduit in finished buildings, procedure. 104
  service switch meter and branch blocks....... 221
Interior wiring, overhead and general expense charges on......... 61
Iowa Railway and Light Company, Marshalltown, Iowa campaign..... 52
Iron pipe as guide for fishing wire................ 197
Italy, wiring small finished buildings at Milan.. 136

J

Joining rigid vertical conduits........... . . 107
Joists, boring holes in........ 171
  pipe-extension tool for boring through...... 174
  slotting for conduit...... 103

Junction boxes and distribution cabinet in a combination rigid-and-flexible conduit installation 121

K

Kansas City Electric Co., rates for wiring.......... 81
  Light Co., campaign... 49
  Mo., illuminated sign advertising in.......... 13
Kitchen-or-Laundry wiring plan used in Kansas City............... 49
Knob and tube method carrying conductors floor to floor............ 125
  description of wiring a two-story and cellar building by......... 229
  of wiring a bracket.... 127
    ceiling outlets....... 126
    finished frame buildings............. 217
  wiring for finished buildings.. 123
    prices for........... 83
    prohibition of...... . 144
  on snake for fishing...... 187
Kuhlo wire.................. 137
  economy and applications of............. 142
  installation of........... 138
  outlets and other fixtures for.......... ... 141

L

Labor costs, N. E. L. A...... 60
Lamp or socket, unit price per. 58
Lamps, electric exploring..... 182
  for finished-building wiring installations..... 37
  home-made exploring.... 179
Lath at outlet hole, removing. 170
Lead pellet mouse........... 184
Letters, advertising enclosures with............... 98
  circular................. 11
    form of.............. 98
  form.................... 94
  multigraphed on letterheads.............. 95
  subject matter of 98
Lighting installation......... 91
Limiting devices............. 37
List of prospects.......... .. 95
Locating center of ceiling..... 214
Locator, magnetic............ 183
Long-distance boring tool.... 173
Looped snake device, mouse and................ 190
Louisville, Ky., Gas & Electric Co. campaign....... 50
  premiums to solicitors. 31
  The H. M. Byllesby Co. campaign at........ 42

M

Magnet for locating outlet ... 183
Magnetic locator............ 183
Magnetized hook for fishing.. 189
Mailing circular letters, dates of................. 97
Manchester, N. H., display cards used in....... 14
Manipulation of the pipe-extension boring tool.. 175
Marshalltown, Ia. campaign.. 52
Master switch circuits....... 153
McKirdy, J. E., and Howard H. Wood, notes from papers of........... 19
Mediums of advertising, different methods or... 7
Metal molding installations, cost of............ 130
  wiring............... 128
    rules............... 129

- Metallic conduit and flexible armored conductor, constructions, application and grades of. 114
  - wiring.......... 113
    - for medium-grade finished buildings, prices of flexible..... 74
  - flexible conduit outlet box in metal ceiling . 117
- Meter installation........... 221
  - location, selection....... 145
- Method of estimating........ 92
  - of removing floor boards. 161
- Methods, miscellaneous, in finished-building wiring................ 212
  - of cutting small pockets. 167
  - of determining cost and prices for finished-house wiring........ 50
  - of exploring wiring spaces. 184
  - of payment............. 32
  - of wiring, European..... 135
    - finished buildings...... 101
  - or mediums of advertising 7
- Michigan Electric Co., South Bend, Ind. campaign 51
  - charges for wiring..... 83
- Middle West, percentage of houses wired in..... 1
- Minneapolis, H. M. Byllesby Co. premium campaign in............ 40
- Mirror for exploring wiring spaces............. 180
- Miscellaneous installations... 249
- Mobile Electric Co. charges for wiring.......... 78
  - flat-rate installations.. 58
- Moisture, metallic conduit must not be subjected to................. 118
  - use of rigid and flexible conduit where run is exposed to.......... 120
- Molding, boring plaster-of-Paris canopies and.. 170
  - conductors carried concealed within....... 132
  - dead, use of............ 134
  - for extensions to existing installations, wooden. 133
  - wiring, metal........... 128
    - prohibition of......... 144
    - wooden............... 130
  - wooden, forms of........ 131
- Mt. Vernon, Ill. campaign.... 53
  - rates for wiring......... 83
- Mouse and looped snake device............... 190
    - construction of 191
    - manipulation of the... 191
    - substitute for the..... 192
  - lead pellet.............. 184
  - the.................... 184
- Moving picture theater advertising.............. 99
- Muncie, Ind. Electric Light Co. campaign....... 51
  - prices and terms of payments.......... 81
- Municipal wiring requirements.............. 144
  - rules, effect on cost of wiring............. 61

N

- Nails in trim should be punched through.... 168
- National electrical code requirements, wiring a bracket to meet. 124
  - rules 144
    - effect on cost of wiring......... 61
    - metal molding.... 129
    - wooden molding..... 131
  - Electric Light Association's booklet, "Electric Service in the Home"....... 16

National Electric Light Association report cost data in . . 60
    of committee on wiring existing buildings, customers per capita .. 1
  Metal Molding Co.'s ovalduct 112
Neatness and how attained. 157
New buildings per thousand population 5
Newspaper advertising. 9, 99
  electrical page 19
Number of lamps, price per outlet varies with . 59
  of outlets and sockets, relation of 60

O

Obstructions in walls and partitions, methods of passing 201
Order for wiring already built houses 17
Outline of house-wiring campaign for Dawson Light & Power Co 86
Outlet box, bracket, wiring to. 239
  ceiling, method of installing 239
  for flexible metallic conduit in furred ceiling. 117
  in metal ceiling 117
  installation of bracket 107
  last step in flexible conduit job 117
 boxes in conduit installations.... 103
 connecting a ceiling 233
 holes, cutting..... 169
 partition, near a doorway. 202
 switch, method of wiring 231
 under parquetry border, reaching a ceiling ... 210
Outlet, unit price per... . 58
  wiring for a side. 131
    from a partition to a ceiling outlet....... 212
Outlets and sockets, number of, relation between. 60
  and fittings for Kuhlo wire. 141
  baseboard, wiring to..... 246
  cost of wiring standard ceiling............ 67
  fishing to ceiling or center... 209
  flexible tubing at 124
  getting past obstructions to wall and partition. 201
  in partitions, running wires to 200
  in stone or brick, charge for. 69
  metal molding, charge for 69
  one vertical conduit run can serve two.... . 123
  switches and extras, switch prices.. 73
Ovalduct 112
Overhead and general expenses, interior wiring 61

P

Pacific Coast, percentage of houses wired. 1
Panel box, conduit for feeder between entrance and............... 104
    construction of a...... 147
    details....... .. . 148
    distribution center.. 147
    installation.......... 149
    in rigid conduit work . 105
    trim............. . . 149
    wiring a building large enough to justify the installation of a..... 234

Panel box, wiring to......... 237
  boxes, installations without................ 217
    wrought iron conduit in................. 150
Parquetry floors, cost of cutting............... 62
  wood border, reaching a ceiling outlet located under a............ 210
Partition, attaching outlet box in........... 116
  interiors, exploring.. 178, 181
  making a pocket into space in a.......... 164
  outlet near a doorway... 202
    to a ceiling outlet, method of wiring from. 212
Partitions, wiring between.... 206
Payment, methods of........ 32
Payments, terms of, Muncie, Ind................ 81
Pennsylvania Electric Association paper....... 19
Percentage of houses, wired.. 1
Personal canvass............ 19
Peschel tube system......... 136
Pipe as guide for fishing wire. 197
  wrench, turning boring tool with........... 175
  extension boring tool..... 173
    dowel joint for.... ... 175
    manipulation of...... 175
    tool, turning with pipe wrench............ 176
Pittsburgh, Pa. advertising... 21
  campaign.............. 47
Placards used in Manchester, N. H. campaign.... 14
Planning an installation...... 144
Plastered surfaces, cutting outlet holes in...... 169
"Plaster Hose" system in Austria............ 137
Plaster-of-Paris, boring..... 170
Pocket, cutting a small...... 166
  floor, running conductors from, to partition without disturbing baseboard.......... 212
  making one in a partition 164
Pockets, how to make........ 159
Point of entrance selections... 145
Policies..................... 32
Policy in regard to fixtures... 35
    to furnishing lamps.... 37
Possibilities and results, table of................. 5
  of the small customer.... 2
Post cards.................. 98
  card with letters........ 94
Posters and billboard advertising.............. 13
Preliminary information sheet 56
Premium campaign in Minneapolis 40
"Premium" campaigns advertising example...... 40
Premiums as a stimulant to solicitors.. 31
Price for wiring finished frame buildings, average... 63
  of wiring finished buildings, switches, switch outlets and extras... 73
  per lamp or socket, unit.. 58
  per outlet...... 58
  schedule, advantages of carrying a simple... 28
    of Baltimore Light Co. 70
    unit............... 69
    Union Electric Light and Power Co...... 77
Prices and costs of finished-building wiring...... 54
  and estimating.......... 35
  charged for wiring finished buildings, North Central City....... 77
  for finished-building wiring, South Bend, Ind. 83

Prices for wiring, Kansas City Electric Co. 81
  lamps and fixtures in Mobile, Ala. 78
    Mt. Vernon, Ill. 83
  list for finished-building wiring. 61
  N. E. L. A. 61
  miscellaneous, Baltimore Co. 71
  of concealed knob and tube wiring. 83
  of Edison Electric Illuminating Co., Boston, Mass. 79
    Brooklyn, N. Y. 76
  of extras, costs and. 68
    and list. 68
  of fixtures. 253
  of flexible conduit wiring. 74
    metallic conduit wiring for medium-grade finished buildings. . . . 74
  of Muncie Electric Co. . . 81
  of outlets of various types 67
  of services, entrances and runs to centers of distribution. 66
  of wiring in different localities. 62
  standardized or unit. 56
Profits on and list prices for finished-building wiring. 61
Properties and dimensions of rigid conduit and conduit fitting. 102
Proposal for wiring, typical. . 30
Prospect list. 95
Pulling fixture wires past a right angle. 195
  flexible conduit, device for. 118
Pulling-in line, sash cord for. . 190
Pull-socket chain for fishing. 185

R

Ratchet drills for boring floor and ceiling plates. . . 172
Rate of growth. 2
Rattan snake. 189
Reading notice advertising. . . 24
Record of unwired buildings, card. 26
Relation between number of outlets and sockets. . 60
  of advertising to selling. . 92
Relations with contractors. . . . 33
Removal and replacement of trim. 168
Removing baseboards, tools for. 168
  floor boards with a chisel. 161
  trim. 168
Rental of fixtures in Europe. . 36
Report of committee on wiring existing buildings, National Electric Light Ass'n. 1
Residence wiring, contract and specifications for. . . . 89
Results and possibilities, table of. 5
Right angle, pulling fixture wires past a. 195
Rigid and flexible conduit, combination of. 119
  conduit in finished buildings, procedure for installing. 104
    installed on exterior of building. 110
      on residence exterior. 249
    substituted for flexible 121
    wiring. 102
  or flexible conduit in brick or masonry walls. . . . 122
  vertical conduits, joining. 107
Riser in building of several stories, conduct. 110

Rod, steel measuring, used instead of snake or mouse. 188
Round outlet boxes in plastered surfaces . . . 170
Routes for conductors. 145
Rules of National Electrical code, metal molding. 129

S

Salesman, expert estimator is seldom a good. 25
  personal follow-up by . . . 98
  -solicitors. 25
Salesmen, stimulation of . 92
  wiremen as electrical-goods. 30
Sash cord pulling in lines. . 190
Saw, flooring, for finished-building wiremen. . . . 160
  for removing floor boards. 159
Sawing out a lath at outlet hole 170
Saxony, rental of fixtures in . 36
Scraper, cutting floor boards tongues with. 163
Sectional steel rod instead of snake or mouse. 188
Selling, relation of advertising to 92
Service entrance, flat price for 59
  switch. 221
Services, costs and list prices. 66
Side outlet, wiring for a. 131
  outlets, running conductors to. 200
Sign advertising in Kansas City, Mo. 13
Signs, electric. 19
Sill, carrying conductors around or through a. 205
Sizes, calculation of wire. . . . 146
Slotting joists for conduit. . . 103
Small customer, possibilities of. 3
Snake device, manipulation of the mouse and looped. 191
  mouse and looped. . . . 190
  for fishing, knob on end of 187
  or fishing wire. 186
  or mouse, sectional steel rod instead of. 188
  rattan. 189
  steel measuring tape as a. 188
  with weighted end. 187
Snakes, fishing with two hooked. 196
Socket, unit price per 58
Sockets and outlets, number of, relation between. 60
Soft-wood flooring, taking up. 162
Soldering connections. 213
Solicitation. 25
  districts, division of a community into. . . . 26
  group method of . . . 48
  in Germany, methods of 30
Soliciting business, estimators 29
  card, sample. 27
  personal canvass 19
Solicitors, cash premiums as a stimulant to 31
  estimator and salesman. . 25
  finished-building wiremen as. 30
  should carry pictures and prices of fixtures. . . . 36
South Bend, Ind. campaign. . . 50
  prices for wiring. 83
Specification and contract. . . . 89
Specifications for house-wiring campaign for Dawson Light & Power Co 85
Splicing flexible conduit . . . 114
Splitting of boards, how to avoid. 168
Standardized or unit prices. . . 56

Stannos wire............. 142
Steel armored cable or flexible conduit, installation of a wall bracket box for... 114
  wiring a three-story city residence with flexible........... 234
  conductor or flexible steel cable. 113
  fish bit............. . .. 178
  wire, dimensions of. 186
  hook fishing tool.... 189
  measuring tape as a snake. 188
Stimulation of salesmen. ... 92
St. Louis campaign, fixtures used in 256
  Mo. Union Electric Light and Power Co. campaign at............ 44
  price schedule of Union Electric Light & Power Co.......... 77
Street car advertising........ 99
  cards 12
Strips, furring. 152
Styles of fixtures to feature . 256
Substitute for mouse and looped snake device. 192
  for wall fixture 207
Substitution of rigid for flexible conduit........ 121
Supporting electroliers fed from attic........ .. 108
Switch box for flexible conduit 116
  installation of rigid conduit.............. 106
  boxes, cutting holes for . 169
  installing a flush...... .. 208
  mounting in bath room.. 248
  outlet, method of wiring a. 231
  outlets, switches and extras, prices......... 73
Switches, labor cost for installing 61
Switches, wiring a building with double-pole . . 251
  wooden base blocks for. . 128
Symmetrical appearance, placing dead molding to insure............ .. 134

T

Table of possibilities and results................ 5
Tape, steel for snake.. 188
Terms of payment of the Muncie Electric Light Co. 81
Three-way and emergency switch circuits 153
Three-ways witches, details, etc. 225
  way and emergency switch circuits...... 153
  switches, detail of wiring for hall lights with............... 225
Time-payment proposition... 86
Toledo, Ohio, electric light users in............ 2
  Railway & Light Co. campaign......... ... 50
Tongue and groove flooring, taking up.......... 164
Tool, door knob, for boring from outlets 171
  exploring bit... 182
Tools, boring.. 170
  brick drills... 213
  for fishing 183
  for removing baseboards 168
  the mouse.. 184
Trim, construction and installation of the panelbox... 149
  removal and replacement of................ 168
  removing.............. 168
Tube and knob wiring for finished buildings. ... 123
  system, Bergmann...... 136
    Peschel.............. 136

Two-wire emergency circuits. 155

U

Umbrella as dirt catcher..... 158
Underwriters' wiring requirements............ 144
Union Electric Light and Power Co. campaign at St. Louis......... 44
  circular includes contract........... 16
    street car advertising 13
Unit price per lamp or socket. 58
  schedule of Baltimore Light Co......... .. 69
  prices................ .. 56
United States, number persons using electric lights. 1
Unwired buildings, card record of.... . 26

V

Vertical conduit run can serve two outlets....... .. 123
  conduits, joining rigid... 107

W

Wall bracket box for steel armored cable or flexible conduit. . . 114
  paper, cutting, to expose plaster.......... 204
  switch box, installing a.. 208
Weight-and-chain mouse.. . 184
Werdan Saxony, rental of fixtures in 36
West Penn. Traction Company, Butler, Pa. campaign........ . 52
Wire, a snake or fishing.... 186
  bare concentric (Kuhlo wire............... 137
  dimensions of steel fish wire............... 186
  fishing, angling rod for... 193
Wire fishing, helpers work in.
  Kuhlo.................
  sizes, calculation of.....
  weighted end fishing.....
Wired houses, not using current...............
Wiring a bracket, knob and tube method of..... 1
  to meet code requirements..............
  a building large enough to justify installation of panel box or distribution center....... 2
    with double-pole switches............ 2
    with flexible conduit or flexible armored cable................
  apartment..............
  a small frame building, example.......... .
  a two-story and cellar building by knob and tube method........
  a three-storied city residence with flexible cable..............
  between partitions.......
  buildings with cinder-filled floors.........
  campaign, advertising cost of a...........
    the desideratum of..
  finished-building, estimators work in a....
  campaigns, the bargain feature in..........
  ceiling outlets, knob and tube method of.....
  effect of Municipal wiring rules on cost of...
  emergency or burglar....
  exposed conduit for finished-buildings...... 1
    for finished buildings.. 1

ng finished buildings in England....... .. 142
in Europe.......... 135
cost of........... 84
rates charged by Kansas City Electric Co.. 81
finished building, soldering connections in. 213
use of flexible tubing or circular loom in. 123
fixtures and lamps, policy. 87
five-story buildings with steel-armored cable.. 243
flexible metallic conduit. 113
steel-armored conductor or flexible steel cable for...... 113
for a side outlet with molding............ 131
for bracket outlets...... 241
for finished buildings, methods of......... 101
for hall lights with three-way switches, details of................ 225
or medium grade finished buildings, prices of flexible metallic conduit............... 74
rom a partition outlet to a ceiling outlet...... 212
n Europe, methods of... 135
nstallations, fixtures for finished building ... 252
knob and tube.......... 123
metal molding.......... 128
methods of............. 101
neatness in finished building........... 157
Wiring of a five-story-and-basement building with flexible steel armored cable...... 243
of finished frame buildings by knob and tube method........ 217
overhead and general expense charges on interior.............. 61
plan used in Kansas City, double-socket kitchen or laundry.. 49
price schedule, carrying a simple... 28
rigid conduit. 102
small finished buildings at Milan, Italy..... 173
spaces, exploring.. 180
specifications and schedule of prices, Louisville, Ky.. 14
three-way switch........ 453
to baseboard outlets 246
to panel box............ 237
wooden molding......... 130
Window display advertising. 15, 99
Windows, construction around. 152
Wood building construction.. 150
Wooden base blocks for fixture and switches... 128
molding and flexible tubing combination..... 133
for extensions to existing installations..... 133
forms of... 131
installation of......... 131
wiring............ . 130
Wrought iron conduit in panel boxes.............. 150